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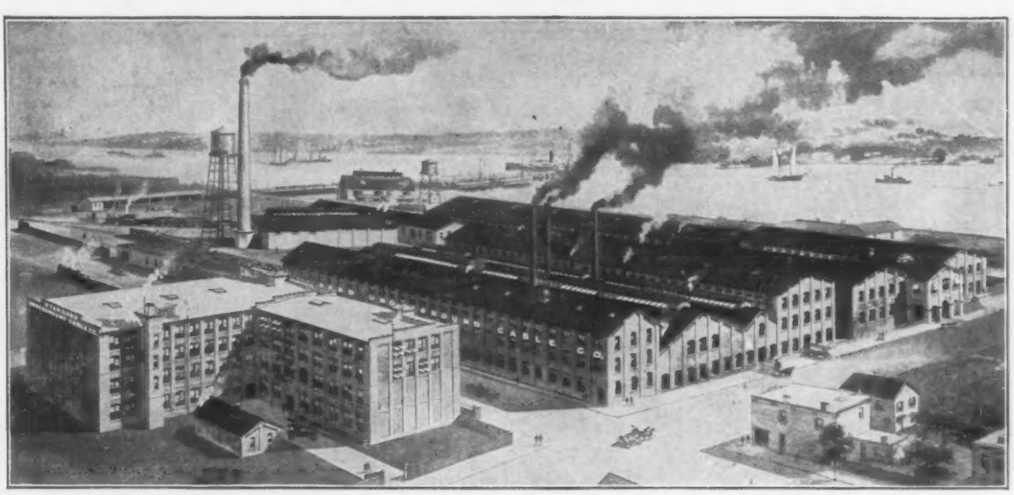

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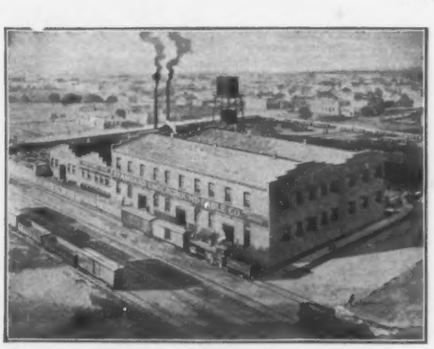

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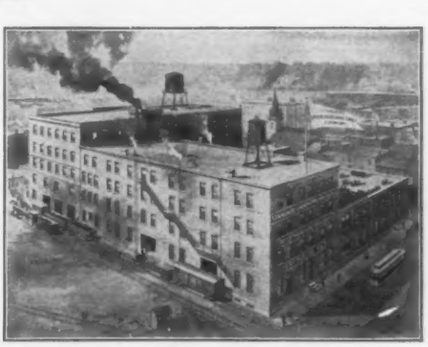

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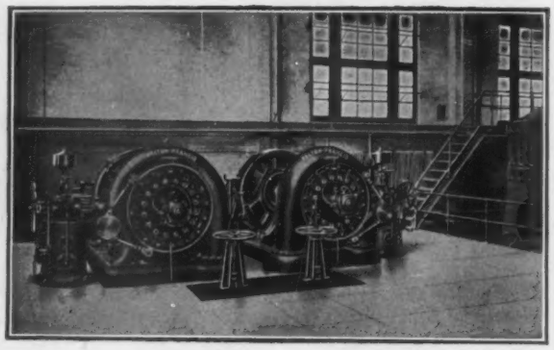

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**Albany	800
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Alvarado	200
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Antioch	3,000
††Auburn	2,050
Barber	200
**Belmont	600
Belvedera	350
Benicia	2,500
**Berkeley	42,000
Big Oak Flat	150
Biggs	750
Black Diamond	500
Brentwood	200
Brighton	100
Broderick	500
‡Brown's Valley	50
**Burlingame	5,000
Byron	200
Campbell	1,000
Cement	1,500
‡Centerville	20
Centerville	500
**Chico	13,000
**Colusa	2,700
†Colfax	400
Colma	500
Concord	1,500
Cordelia	150
Corte Madera	350
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Davenport	1,000
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Encinal	20
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Kentfield	200
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Livermore	2,250
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San Andreas	200
San Anselmo	2,500
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San Carlos	100
**San Francisco	450,000
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San Leandro	4,000
San Lorenzo	100
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San Pablo	1,000
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ELECTRICAL FEATURES PANAMA-PACIFIC INTERNATIONAL EXPOSITION

BY HAMILTON WRIGHT.

While all plans for exhibits at the Panama-Pacific International Exposition in 1915 are in a process of evolution at the present time, and any outline of what may be accomplished must, therefore, be somewhat speculative in its nature, yet the absence of any ordinary limitations upon the huge total of electrical power available for the Exposition, the character of the displays planned and the extraordinary progress of recent years in the application of electricity to the most varied commercial uses, all promise that visitors will have set before them the greatest diversity of electrical features ever exhibited in a single locality.

There is every reason why a World's Exposition held in California should have from the very beginning a great advantage for the display of electrical features. In the development and perfection of extremely long distance high-tension transmission lines California is, historically, first. The world's first experiment in electrical transmission was made in Germany in 1891. From Lauffin a line of 108 miles was run into Frankfort to light an exposition held there that year. Within a year the first electrical power plant in the United States, in which, as a prime mover, water was used, was begun at Pomona, Cal. This

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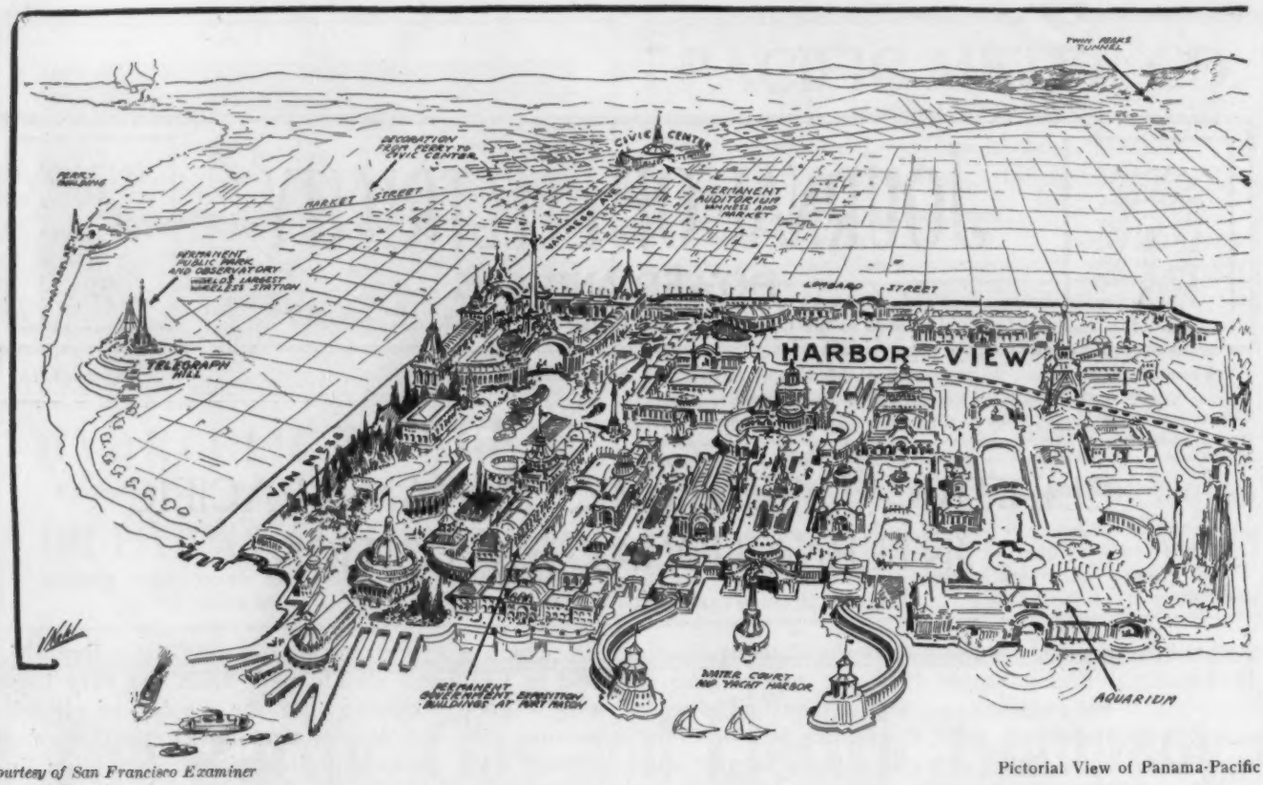


Courtesy of San Francisco Examiner

Pictorial View of Panama-Pacific

was followed by the big plant at Folsom, Cal., which, at that time, was the largest in the world. The first current that flashed along its wires carried 400 horse power 21 miles at a voltage of 11,000. The work on the Folsom plant was only second to that at Niagara Falls and the great plant furnished 45,000 horse power, transmitted a distance of 24 miles to Sacramento for use by street car lines, electric lighting companies and in factories and machine shops.

The success of the Folsom plant was only made possible by the fact that the year after it started a dynamo was invented which made electric power available for manufacturing purposes. The first plants could employ their currents for lighting and for the propulsion of street cars alone, but here was a new application which made the patronage and profits of the concerns doubly sure. Electric power was eagerly caught up all along the transmission lines and today in California it is used for the greatest variety of purposes. At the Exposition California alone could show as wide a diversity of the application of electrical power to commercial uses as perhaps any other region. Only a fraction of the possible power has been developed. The Great Western Power Company's new plant affords one an opportunity to estimate future vast developments.

Since its first amazing development of electricity from the fall of Sierra streams California has steadily progressed in the utilization of this natural power until today the supply of electrical power is secured practically as rapidly as it is needed for the expansion of the industries of the state.

The rapid development in the long-distance transmission of power, as well as the great magnitude of the transmission industry in California, was traceable to the absence of known coal deposits in this state at the time when power began to be needed in industry. The price of mechanical power was correspondingly high. Since California turned its engineering effort to the water-fall as the most promising source of energy, fuel oil has been developed in abundant commercial quantities and it, too, is used in the generation of electrical power.

With these two favoring circumstances, the generation of electrical power from Sierra streams and also from crude petroleum, the cheapest and most easiiy handled fuel, those who have charge of the electrical division of the Exposition will have for the spectacular night displays an abundance of cheap power, an important consideration where much power is to be used.

While contributing little that is material to the advancement of science, the night illuminations will be the permanent dazzling feature of the Exposition and an effort will be made to render them artistic.

The plans for the Exposition site and the adornment of San Francisco lend themselves to superb electrical effects. Imagine, for instance, how a brilliant spectacle will be afforded from San Francisco Bay at night when Telegraph Hill, 287 feet high and abruptly rising above the water front, is illuminated with incandescents; when the Harbor View site of the Exposition with its planned yacht harbor is brilliantly illuminated, and when Lincoln Park, towering above the Golden Gate and the supreme observation point of the entire site, sparkles with light. The boulevard connecting these points will necessarily be illuminated and from a great distance the outlines of the prominent landmarks of the Exposition will be clearly defined. At Lincoln Park will be erected a huge commemorative statue welcoming ships to the Golden Gate and in its general import corresponding to Bartholdi's

International Exposition.

Statue of Liberty in New York harbor. This statue will lend itself to strings of light, as also will a lofty wireless tower that will surmount Telegraph Hill. The whole will be a magic fairyland. Indeed ,the decoration of the prominent observation points gives play for the highest artistic conceptions and it is planned that to observers both near and far the electrical decorative effects shall convey the spirit of the Exposition.

Market Street and Van Ness Avenue, the main boulevards of San Francisco, which, running from San Francisco Bay, meet in an apex in the geographical heart of the city, will be brilliantly illuminated and, although being in the heart of San Francisco, these thoroughfares do not afford the artistic scope that is permitted by such rugged outlines as Telegraph Hill and Lincoln Park, yet they will give a chance for the most novel electric lighting effects. To sum up—it is planned to make the night illuminations the most brilliant and pleasing the world has known and the many eminences available will stand out in silhouette through brilliant chains of light. When the Exposition opens, the illumination of the battle-ships of the world, assembled in San Francisco Bay, will contribute to the striking effect.

Aside from the general electrical lighting effects of the Exposition as a whole there will be an electrical exhibit building, such as the Palace of Electricity at the Universal Exposition held at St. Louis. Because of the marvelous advance made in the application of electrically conveyed energy to industrial undertakings the electrical exhibit promises to be one of the great centers of attractions at the Panama-Pacific International Exposition. It was suggested by the special committee on sites, whose report was unanimously adopted, that the electricity building be located in the two hundred acres of privately owned land between Lincoln Park and the Golden Gate Park site. Here also will be the foreign buildings and machinery in action from foreign countries will be shown. Indeed, the large number and variety of operating exhibits will render the electrical building most instructive and entertaining to the layman.

The largest classification both in area of space and number of exhibits will, necessarily, be that of the machines for generating and using electricity. Dynamos and motors of all the principal makes, both alternating and direct current, will be on exhibition, most of them running. Motor-generators, rotary converters, transformers, rheostats and regulators of every form will be so arranged and connected as to demonstrate their various functions. At the Pan-American Exposition in Buffalo ten years ago one of the most attractive of all the exhibits was the Niagara Falls Transformer plant, a plant having a capacity of 5000 horsepower, consisting of 250 Kilowatt air blast transformers for transforming the power from Niagara Falls delivered at 11,000 volts for distribution about the grounds by means of smaller electric transformers at various points. Near this transformer plant was a working model of the wonderful creation of the Niagara Falls Power Company. No doubt in 1915 a much larger transformer will have been erected at the Panama-Pacific International Exposition supplied with the vast energy of the Sierra streams.

Of the greatest interest and of the highest practical value to the miners of the West will be exhibits of the latest developments in electrically run drills, hoists, fans and other apparatus, while the application

of electrical power in the exhibits representing the production of chemical products such as aluminum, carborundum, carbide of calcium, cyanide of potassium, bleaching powders and other compounds will afford the manufacturer many helpful and inspiring ideas.

In connection with mining, the operation of the huge gold dredgers of California from the power of Sierra streams should afford an example of one of the most unique and economical methods. When it is appreciated that one man at levers is able to direct the workings of the largest dredge in the world, gold dredge Folsom No. 8, the simplicity of electrically handled dredges may be inferred.

Of tremendous popular interest will be the exhibits illustrating the use of electricity in the form of direct, alternating and intermittent current for the treatment of many forms of diseases, especially chronic cases which have been especially refractory. The use of electricity is widely recognized by physicians of great standing. Indeed, it is probable that no branch of therapeutics has made greater advance than the electrical. The electrical therapeutic apparatus will, of course, include X-ray tubes for physical treatment and for diagnosis, and the Finsen lights which give off actinic or higher light rays and are especially efficatious in the treatment of certain diseases.

In the field of the wireless telephone and especially of wireless telegraphy marvelous exhibits are assured. The directors are planning that there shall be built on the summit of Telegraph Hill the tallest wireless tower that can be constructed. From this tower messages will be signalled to ships passing through the canal. Captain Evelyn Briggs Baldwin, the noted Arctic explorer, expects to set forth from San Francisco in 1913 with two especially constructed ships that will drift with the pack ice from a point north of Behring Straits over or very near the North Pole. Captain Baldwin plans a complete wireless outfit and there is a possibility that if he is unable to communicate directly with the Telegraph Hill station he may send messages to the government stations in Alaska, or the Swedish stations on the coast of Spitzenbergen. It is, therefore, within the range of possibility that his observations of the Polar seas will be chronicled upon the very days that they are made.

A large number of inventions in the line of electric lighting have been made in recent years and these will all be demonstrated in a way which will be exceedingly attractive to the public. Arc lamps of every kind and incandescent lights of every size and color will be displayed. The marine boulevard connecting the principal sites of the Exposition, the chain of lakes in the west end of Golden Gate Park connected by a working model of the Panama Canal, the various cascades and the yacht harbor at the Harbor View site of the Exposition are subjects of illumination. The Cooper-Hewitt vapor arc lamps may be used superbly where it is desired to illuminate water effects such as the miniature Panama Canal, fountains or waterfalls upon the grounds. These lamps emit an intense white light which in the absence of red rays gives a very peculiar effect. Vacuum tube lighting by means of induced currents will also be shown.

In the electrical building special laboratories with complete sets of recording instruments whereby the juries of award and exhibitors may conduct careful and accurate tests upon every kind of electrical apparatus will be installed. The personal judgment of the judges will be reduced to a minimum.

All in all, it is planned to make the electrical features of the Panama-Pacific International Exposition the most comprehensive ever assembled in the world's history. The State of California has assured larger funds than have ever been at the disposal of an exposition at an initial stage and with ample funds and extraordinary interest displayed in the Exposition in all parts of the world, the finest exhibits from exhibitors of this and foreign nations are assured. The Exposition authorities plan that the electrical features of the Exposition itself shall be unsurpassed and they invite the hearty co-operation of the electrical engineers and manufactories of the world. Mr. Edison will be invited to participate in the Exposition and exhibit not only his most recent inventions but those which have the highest value from an historical view point. Among the inventions of the greatest popular interest will no doubt be the storage battery for street car use.

Expositions both in this country and Europe have marked each great step in the advance of high potential practice and the Panama-Pacific International Exposition is to be no exception. The phenomena of high potential currents will be shown beyond anything in this line attempted in previous expositions. While proper safeguards will be thrown about such demonstrations yet they will be made in such a way that the general public as well as electrical engineers may profit by them.

Returning to the field of electro-chemistry: many new processes have lately been developed into commercial possibilities. Electrical furnaces and chemical process in operation would be of the greatest interest and value to the West. The use of electricity in treating ores, when adequately illustrated, will be of immeasurable practical benefit to the mining interests of the West, where there are millions of tons of ore to be developed. The products of the electric furnaces are, as a rule, much purer than the products which are made in any other way and it will be of interest to the public to see the operation and the chemical changes which go on under the influence of the electric arc.

Aside from the great display of machinery and apparatus for generating and using electricity there will be shown electric measuring instruments, apparatus for rapid telegraphy, mechanical apparatus for reproducing sound, electric clocks, motors, starters and controllers, storage batteries, dry batteries, prismatic reflectors, arc lights, illuminated signs, electric headlights and searchlights and the thousand and one devices with which the layman as well as the engineer is familiar.

The Panama-Pacific International Exposition will mark the progress of the world in the advance of the use of electricity and will point the way to the future.

PRIMER OF APPLIED THERMODYNAMICS.[1] FOURTH LECTURE.

Three Physical States of Matter.

The number three seems to pervade all nature. The triune Deity, the three Fates, "the third time is the charm," and a thousand daily occurrences bring this to mind. In the animal kingdom we find a beautiful and striking illustration. The larva, then the catapillar, next the butterfly—three distinct forms. The organism in each case seems to be almost unrecognizable when changed into the other.

Were it not for its exceedingly common occurrence, the three physical states of matter would be perhaps the most wonderful operation of the magic three known to our natural experience. We shall now take the most common substance of all and trace its changes from the solid to the liquid, and then to the gaseous state and see the role that heat forces or principles of thermodynamics play in bringing about these physical changes.

Let us suppose we have before us one pound of ice at 0° F. We now begin to heat the ice, raising its temperature finally to 32° F., which we have found is its melting point. It has required a definite amount of heat to raise the ice to this temperature, nearly ½ B.t.u. for each degree. At 32° F. a peculiar thing happens. We continue to apply heat, but no change in temperature occurs until an additional 144 B.t.u. are added when we find that the ice has been entirely melted into a liquid which we call water. We now continue to apply heat and once again we find that the temperature begins to rise; this time, however, almost twice as much heat in proportion to the amount for the ice is required to raise the temperature one degree. In other words, practically 1 B.t.u. per degree is required. Upon continuing to supply heat, the temperature continues to rise till 180 B.t.u. have been supplied, and consequently the temperature of the water has become 212° F. under ordinary conditions of atmospheric pressure. At this point once again we continue to apply heat. Then it will be found the temperature is not altered until we have this time supplied the enormous amount of 970.4 Bt.u. when it will be found that the entire pound of water has disappeared in the form of a vapory gas known as steam. If now, we have the steam cooped up so that it can be held together, once again we can supply heat and once again the temperature will begin to rise and once again the quantity necessary for each degree is different.

The first condition above cited is familiarly known as the solid and the heat applied is known as sensible heat. When the heat is applied to the melting ice without raising its temperature, the heat energy is said to become latent and the quantity necessary to melt one pound of ice is known as the Latent heat of Fusion. Again, when the ice has been entirely converted into the liquid state or water and heat again applied until its boiling point or point of ebullition is reached, this particular heat applied is known as sensible heat. At this point latent heat is again necessary to evaporate the water and change it from the liquid into the gaseous state. The amount of heat necessary to be supplied in this case is known as the latent heat of vaporization. In the case of water Henning has given the following equation:

$$r = 141.124\ (689 - t)^{0.31249}$$

in which r is the latent heat of vaporation and t the temperature in Fahrenheit degrees.

In engineering practice, except in calculations for cold storage plants, we do not make use of water or ice below 32° F. Hence our steam table computations use 32° F. as the starting point. In the vaporization of any liquid, then, that quantity of heat which is absorbed in raising the temperature from 32° F. to the temperature of ebullition corresponding to the particular pressure at which vaporization occurs is the sensible heat of the liquid, and in engineering practice is known as the "heat of the liquid."

In our illustration above we assumed that the boiling point of water was 212° F. This is true under ordinary atmospheric pressure. The boiling point, however, is a variable quantity, and it is most essential that at this time we straighten any difficulty or lack of clearness we may have regarding this feature.

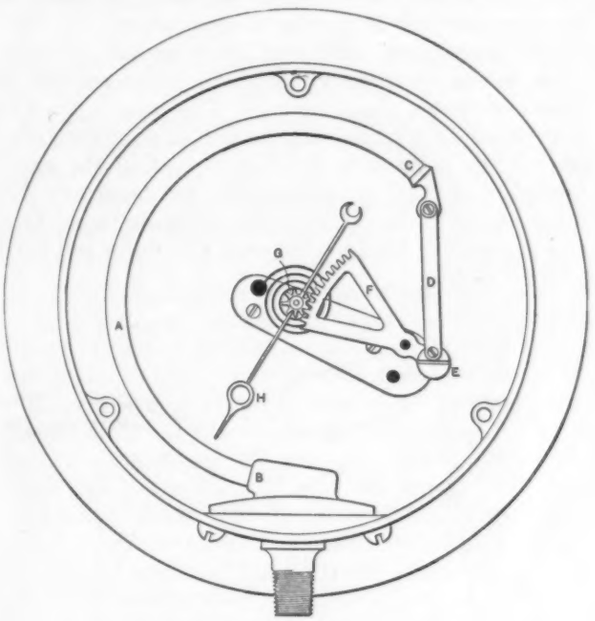


Fig. 11.

It is the experience of mountaineers that on very high mountains, it is difficult or next to impossible to boil eggs, because the water does not get hot enough or, in a word, the water boils far less than 212° F. on a high mountain. Evidently, then, atmospheric pressure is the determining feature. That this is true can be shown in a physical laboratory, for by still further reducing the pressure, water can be practically made to boil at its freezing point. In fact some physical substances do actually change from the solid to the gaseous state without the intervening liquid change. This is known as sublimation. The important point to recall so far as water is concerned and its engineering application in thermodynamics, is that the varying of the boiling point due to pressure necessary varies the heat of liquid necessary to raise the temperature of the liquid to evaporation. Under atmos-

[1] A resume, devoid of higher mathematics, covering the essentials of a series of lectures now being given by the editor of this Journal before the Senior Mechanical Engineering students at the University of California.

spheric conditions we have seen that this requires 180 B.t.u., but it will be proportionately more or less according as the pressure is more or less than atmospheric pressure; that is, 14.7 lb. per sq. in.

The question of pressure, then, has introduced another cardinal property of matter with which it will be necessary for us to concern ourselves in the study of thermodynamics. A cardinal or integral property of a substance is any property which is fully defined by the immediate state of the substance. Any two or three cardinal properties of a substance may be used as coordinates in a graphic representation of the state of the substance. In the study of thermodynamics we concern ourselves with six cardinal properties of matter. In addition to pressure, volume, and temperature, we shall later study internal energy, entropy, and, for wet vapors, dryness. The first general principle of thermodynamics is that if two of the three named cardinal properties are known, these two enable us to calculate the third.

In practice, pressures are measured largely by means of a so-called Bourdon pressure gauge. A Bourdon pressure gauge, shown in Fig. 11, is used to indicate the steam pressure. The tube A is formed from a circular tube which has been flattened until the cross-section is similar to that shown in Fig. 12 as illustrated and explained by Spangler, Greene & Marshall in their excellent little book entitled Elements of Steam Engineering. The tube is then bent into an arc of a circle and the end attachments brazed on. If the tube were circular in section the application of an internal pressure would not cause any movement of the ends. If the tube has a flattened section and pressure is applied, the ends will move outward to a larger radius.

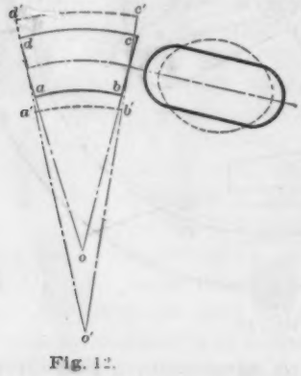


Fig. 12.

Fig. 13.

The action of such a tube can be seen from a consideration of a portion of the tube adcb, shown in Fig. 12. The lines ad and bc represent cross-sections of the tube perpendicular to the center line. The intersection of these lines determines the center O of the circle to which the tube has been bent. If internal pressure be applied to the tube, the flattened surfaces open out, ab taking the position a'b' and cd the position c'd'. These lengths are not materially changed by this action and a'd' and b'c' are the new positions of the sections considered. Continuing these lines gives the new center O' of the arc of this portion under the new conditions. Since the section considered is any section, the action is the same for the whole tube, and as the radii are larger, the free end of the tube must have moved outward, as shown in Fig. 13. Hence by proper graduations an accurate gauge is easily devised.

Practically all of the pressure gauges used in practice read above atmospheric pressure, or, in other words, to get the real or absolute pressure, 14.7 lb. per sq. in. must be added. The use of condensing engines has necessitated the employing of some device to read pressures below atmospheric pressure. A very cumbersome device, or rather a cumbersome scale, is employed, but since it is the one in common use we must look into its make-up. Now it is found that a column of mercury 29.6 inches high will just balance the atmospheric pressure. A column of mercury 1 sq. in. in section and 29.6 inches high weighs 14.7 lb. Hence 29.6 inches of mercury are equivalent to 14.7 lb. pressure. If now a pressure is measured which shows but 19.6 in. of mercury, evidently the pressure has been reduced by 10 inches, or we say 10 in. of vacuum exists. Since 29.6 in. of mercury correspond to 14.7 lb. pressure, evidently each in. of vacuum represents very approximately a reduction of ½ lb. below atmospheric pressure. It is of the greatest importance in speaking of pressure that you should be sure whether your starting point is atmospheric or absolute, and then base your computations accordingly.

In speaking of the rise in temperature of a substance, the amount of heat required to raise its temperature, 1 degree Fahrenheit is called its specific heat. We shall find that this amount of heat varies widely for different substances, and in fact varies somewhat in each substance for different temperatures. In the case of water, for example, we speak of its specific heat as being unity, while to be exact, its specific heat according to Regnault is as follows:

$$\text{Specific heat} = 1 + 0.0004\ t + 0.0000009\ t^2.$$

In which t is the temperature in Centigrade scale.

For the case of solids and liquids a list illustrative of the various specific heats of substances is appended. We shall reserve the question of specific heats of gases until a later lecture. It is observed that water has the highest specific heat of all liquids, hydrogen gas being the only other substance of greater heat absorbing capacity. A general law is also seen that the specific heat becomes greater in the liquid than in the solid and again less in the gaseous state. Aside from the fact that its bountiful distribution in nature makes its use in engineering important as a thermodynamic medium, the large specific heat of water also adds materially as a medium for strong energy.

SPECIFIC HEATS.

Solids.		Liquids.	
Copper	.0951	Water	1.0000
Gold	.0324	Alcohol	.7000
Wrought iron	.1138	Mercury	.0333
Cast iron	.1298	Benzine	.4500
Steel (soft)	.1165	Glycerine	.5550
Steel (hard)	.1175	Lead (melted)	.0402
Zinc	.0956	Sulphur (melted)	.2340
Brass	.0939	Tin (melted)	.0637
Glass	.1937	Sulphuric acid	.3350
Lead	.0314	Oil of turpentine	.4260
Platinum	.0324		
Silver	.0570		
Tin	.0562		
Ice	.5040		
Sulphur	.2026		
Charcoal	.2410		

The amount of heat required to raise a unit of weight of a liquid from freezing point to a given temperature and to vaporize it into dry saturated vapor against the corresponding temperature is called the

total heat. Now it is evident from this definition and from the definition of heat of a liquid previously given in this lecture, that the total heat of vaporization is equal to the sum of the heat of the liquid and the heat of vaporization; if the first is represented by q and the latter by r then H, the total heat, is given by the fol lowing equation:

$$H = r + q.$$

Dr. Harvey N. Davis gives for the total heat of steam in B.t.u. per pound,

$$H = 1150 + 0.3745\ (t - 212)\ - 0.000550\ (t - 212)^2$$

in which t is the temperature in Fahrenheit degrees.

The Economizer.

As an application of the heat of a liquid being used in engineering practice to increase the economy of a steam plant we shall next consider the so-called

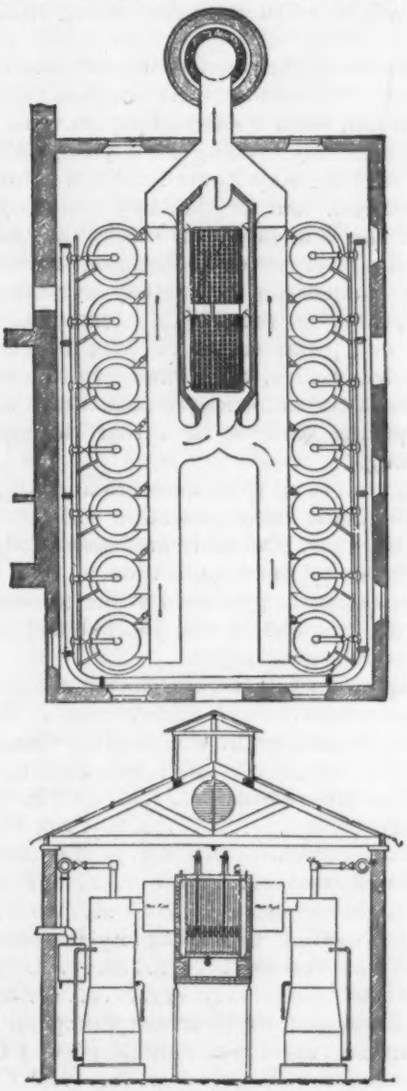


Fig. 14. Green Fuel Economizer.

Economizer. In our last lecture we found under the study of fuels that in spite of every care we may use in the combustion of fuel, still an enormous number of heat units passed up the chimney unutilized. It is evident, then, if some method can be devised to still further absorb the heat of the out-going chimney gases a real saving can be made. Chimney gases usually pass up the flue at a temperature of about 500° F. We have just seen that a certain amount of heat is required to raise the temperature of feed water to the vaporization point, and in a previous lecture we found that the greater the difference in temperature two surfaces are relative to each other when placed in contact the more readily will the warmer element part with its heat. If now we can bring the cool feed water in contact with the hot outgoing gases an economy can be brought about by still further reducing the temperature of the flue-gases, thus causing them to part with considerable heat that would otherwise be wasted. Such a device is known in engineering practice as an Economizer. By a careful installation an Economizer may be made to heat the feed-water as high as 300° F. or more, whereas no ordinary exhaust-steam heater, which we shall later study, can possibly produce a temperature higher than 212° F. It is evident since the specific heat of water is very close to unity, the gain by heating feed water is about 1 B.t.u. per pound of steam for each degree heated; or since the average steam contains 1000 B.t.u. net as we shall later find, the gain is about 1 per cent for each 10° that the temperature is so raised. To be exact the gain is $\frac{H - h}{Q}$, in which Q is the total heat of the steam gained from the temperature of feed to the state at evaporation and h and H the total heats in the water before and after heating. Now if t_c and t be the temperatures of the flue gases and steam, respectively, W the weight, and S the mean specific heat of the chimney gases (usually about 0.24), the maximum saving that can be effected by a perfect economizer is $WS\ (t_c - t)$. Good operation decreases W and t_c and thus makes the possible saving small.

A typical economizer installation is that shown in Fig. 14, which is known in the trade as the Green Fuel Economizer. In order that the economizer may be inspected and cleaned from time to time an arrangement is always made for by-passing the gases. The device consists of vertical castiron tubes with connecting headers at the ends, the tubes being sometimes staggered so that the gases will impinge against them. The external surface of the tubes is kept clean by scrapers, operated from a small steam engine. The tubes obstruct the draft, and some form of mechanical draft is employed in conjunction with economizers. About 4.8 sq. ft. of economizer surface are ordinarily used per boiler horsepower.

THERMOTWISTERS.

1. A boiler evaporates 3000 lb. of water per hour from a feed-water temperature of 200° F. to dry steam at 160 lb. pressure which corresponds to a temperature of 363.6° F. What is its horsepower?

2. In the above problem what proportion of the whole heat in the fuel is carried away in the flue gases, if their temperature is 600° F. assuming the specific heats of the gases to be constant? The initial temperature of the fuel and air supplied is 0° F.

3. In the second problem, what would be the percentage of saving due to an economizer which reduced the gas temperature to 400° F?

SOLUTION OF THERMOTWISTERS FOR FIRST LECTURE.

1. The normal temperature of the human body is 98.6° F. Express in Centigrade and Reaumur degrees.

Substituting in formulas 1 and 3, page 209, and solving for C, we have

$$F = 9/5\ C + 32 \text{ or } 98.6 = 9/5\ C + 32$$
$$9/5\ C = 66.6 \text{ or } C = 37.°0 \quad \text{Ans.}$$

$$R = 4/9\ (F - 32) \text{ or } R = \frac{4}{9}(98.6 - 32)$$

or $R = 29.6°$ Ans.

2. Compute by equations given above at what temperature the Fahrenheit and Centigrade scales read alike. Similarly for the Fahrenheit and Reaumur scales.

Evidently the scales will read alike when $F = C$ in the equation $F = 9/5\,C + 32$, hence substituting $F = C$, we have

$$C = 9/5\,C + 32, \text{ or } C = -40° \text{ Ans.}$$

Similarly in the second case, R must equal F in the equation $R = 4/9\ (F - 32)$, hence substituting $R = F$, we have

$$F = 4/9\ (F - 32) \text{ or } F = -25.6° \text{ Ans.}$$

3. Given that $y = mx + b$ is an equation which represents in general the three thermometer scales in which y or x can be either F, C or R. Compute the two constants m and b by substituting corresponding values on scales for boiling and freezing point of water and thus deduce for yourself the three equations above.

(1) In the Fahrenheit-Centigrade relationship—

At freezing point of water $F = 32$, $C = 0$. Hence substituting in $y = mx + b$, we have when $y = F$ and $x = C$

$$32 = m \cdot 0 + b, \text{ or } b = 32$$

Again at boiling point of water $F = 212$, $C = 100$. Hence substituting, we have

$$212 = m \cdot 100 + b = m \cdot 100 + 32, \text{ or } m = 9/5$$

Therefore in $y = mx + b$, we have

$$F = 9/5\,C + 32 \text{ Ans.}$$

(2) In the Centigrade-Reaumur relationship—

At freezing point of water $C = 0$, $R = 0$. Hence substituting in $y = mx + b$, we have, when $y = C$ and $x = R$—

$$0 = m \cdot 0 + b, \text{ or } b = 0$$

Again at boiling point of water $C = 100$, $R = 80$. Hence substituting, we have

$$100 = m \cdot 80 + b = m \cdot 80, \text{ or } m = 5/4$$

Therefore in $y = mx + b$, we have $C = 5/4$ Ans.

(3) In the Reaumur-Fahrenheit relationship—

At freezing point of water $R = 0$, $F = 32$, Hence substituting in $y = mx + b$, we have when $y = R$ and $x = F$—

$$0 = m \cdot 32 + b, \text{ or } b = -32\ m \quad (a)$$

Again at boiling point of water $R = 80$, $F = 212$. Hence substituting, we have

$$80 = m \cdot 212 + b, \text{ or } b = 80 - 212\ m \quad (b)$$

Eliminating b from (a) and (b), we have

$$-32\ m = 80 - 212\ m, \text{ or } m = \frac{4}{9}. \text{ Hence } b = -4/9\ 28/32$$

Therefore in $y = mx + b$, we have

$$R = 4/9\ F - 4/9\ 32, \text{ or } R = 4/9\ (F - 32) \text{ Ans.}$$

NINETEENTH ANNUAL CONVENTION PACIFIC COAST GAS ASSOCIATION.

It was a notable gathering that met in Oakland during the past week and one that will long linger in the memories of all those who attended the sessions of the annual convention of the Pacific Coast Gas Association.

Delegates to the nineteenth annual convention of the Pacific Coast Gas Association gathered at Foresters' Hall, Thirteenth and Clay streets, Oakland, at 10 o'clock a.m., September 19th, and took preliminary steps toward the establishment of a gas engineer degree at the University of California. The sum of $6000 was subscribed by members of the association, who agreed to pay pledges in five annual installments until the required sum has been entirely paid up. John A. Britton of the Pacific Gas and Electric Company, secretary-treasurer of the association, originated the idea.

In point of attendance the convention was the largest which has ever been held in the history of the association. Frank A. Leach, Jr., manager of the Oakland Gas, Light and Heat Company, called the meeting to order as president of the association. A large delegation of Southern California gas men carried large gilt buttons in their lapels announcing that San Diego aspired to the annual convention next year.

Because of its inactivity, the committee appointed at the last convention of the association to prepare for a national convention in San Francisco in 1915 was dissolved, and John A. Britton, as secretary, read a copy of an invitation issued by the gas corporations of the Pacific Coast to the officials of similar concerns throughout the country to attend a national congress in San Francisco during the time of the Panama-Pacific Exposition. John A. Britton, Leo A. Lowe, W. B. Cline, John Martin and George H. Collins were appointed to look after the affairs of the national gathering to be held here in 1915.

Leach, in his opening address, talked of the new corporation tax, and also spoke strongly against the employers' liability act and gave a general discussion of the various amendments which affect the gas men, and which will be voted on at the coming election next month.

The sessions of the convention continued to Thursday evening. Wednesday was devoted to another business session, when a series of papers were read. At 7 o'clock Wednesday evening a banquet was served to the delegates at the Key Route Inn. On Thursday the delegates made a tour of Oakland, including the inspection of the Standard Oil Works at Richmond. Luncheon was later served at Piedmont Park.

At the banquet on Wednesday evening John A. Britton appeared as the amiable toastmaster of the occasion. The jovial stunts of John F. Parker and E. T. Van der Naillen, the former as songmaster and "jollier," the latter as burlesque councilman and "Portugee," kept the banquet in a roar throughout the entire evening.

Taking it all in all the nineteenth annual gathering of the Pacific Coast Gas Association will go down into history as the most profitable and pleasant gathering ever undertaken by the organization.

The entire papers presented at the convention will appear in the columns of the Journal and will commence in the following pages.

The papers read at the convention are as follows:

President's Address.....Frank A. Leach, Jr.
Unstable Hydrocarbons in Illuminating Gas.....
.....E. C. Jones
Suburban Gas Distribution.....C. S. S. Forney
Rate Fixing.....Prof. C. L. Cory
The Napthalene Problem in Oil Gas Manufacture
and Distribution.....F. S. Wade
Early Gas Lighting.....W. R. Morgan
Mechanical Handling of Carbon By-Products of
the Oil Gas Process.....D. J. Young
The Gas Meter.....W. M. DuVal
Measures Employed to Decrease Complaints of
Customers.....San Diego Gas Company
Wrinkles.....F. C. Millard
Experiences.....John D. Kuster
Novelties.....John Clements

The officers for the Pacific Coast Gas Association elected at the meeting Wednesday are William Baurhyte, president; H. E. Adams, vice-president; J. A. Britton, secretary; H. Bostwick, assistant secretary. The directors are H. C. Keys, C. S. Stants, S. W. Coleman, H. H. Jones, C. Halbertion and R. Thompson.

PRESIDENT'S ADDRESS.

BY FRANK W. LEACH, JR.

As president of the Pacific Coast Gas Association and as a citizen of Oakland, I am very pleased to welcome you here this morning in our Nineteenth Annual Convention.

The year just finished has been one of great activity and importance to the gas and allied industries on the Pacific Coast. There has been an ever-increasing demand for our commodity. New avenues for output have been opened and established sources of income enlarged. The field for industrial appliances continues to increase and it is now the exception to find a factory, laundry or workshop that is not using gas in some part of its operation.

There has been an increasing demand for gas for illumination notwithstanding the great improvement in electric incandescent lamps during the past year. The introduction of high-efficiency electric lamps with their long white rays have popularized the brilliant white light of the gas arc and other mantle burners. The manufacturers of gas arcs have kept pace with the improvements of electric manufacturers and there is today a strong demand for this form of illumination.

Light is popularly judged by comparison; artificial light is compared with sunlight, one artificial illumination with another. And gentlemen, from my observation of present day gas illumination, we, as gas men, have no apologies to make; nothing to fear; simply to send out our solicitors and the business is ours.

There has been introduced a new inverted double burner for street illumination which is being installed in this city with great satisfaction. Already approximately 500 have been installed and 200 more have been ordered. They are being placed in the thickly settled residence districts where the sidewalks are lined with shade trees and where the old form of street lighting by electric arcs 300 feet apart was practically useless. Thus not only are new avenues of revenue opening to us, but also are we again coming into our own.

The extensive development of the oil fields has continued. New gushers have been brought in with many supplying enormous quantities of gas at great pressure. This gas has been conserved in a very limited way to date. Only a few small towns in the immediate vicinity are supplied, although a considerable quantity is being used under boilers in the fields. Reports have come from time to time that the gas wells were already showing signs of giving out; but experienced gas men from the Eastern fields say they look for large development of this branch of their industry in the near future. The development of many individual producers of varying quality of oil has caused much concern to the gas companies buying from distributing companies. The difference in gravity and impurities is sufficient to cause great inconvenience in manufacture.

The advance in manufacture has been confined mainly to refinement in our well established systems of oil gas which have come into general use in California. The use of residual carbon in the manufacture of carbureted water gas has been demonstrated a success and it is now possible to regulate the production of carbon within the limits of its use for that purpose.

Under Senate Constitutional Amendment No. 1, adopted October 5, 1910, becoming effective January 1, 1911, and approved by the citizens of California ununder the Act of the Legislature (Chapter 335, approved April 1, 1911), the entire system of taxation for State purposes has been changed.

Section 1 sets forth: "Taxes levied, assessed and collected as hereinafter provided upon railroads, including street railways, whether operated in one or more counties; sleeping car, dining car, drawing-room car and palace car companies, refrigerator, oil, stock, fruit, and other car-loaning and other car companies operating upon railroads in this State; companies doing express business on any railroad, steamboat, vessel, or stage line in this State; telegraph companies, telephone companies; companies engaged in the transmission or sale of gas or electricity; insurance companies; banks, banking associations, savings and loan societies, and trust companies; and taxes upon all franchises of every kind and nature, shall be entirely and exclusively for State purposes, and shall be assessed and levied by the State Board of Equalization, and collected in the manner hereinafter provided. The word 'company' and the word 'companies' as used in this act shall include persons, partnerships, joint stock associations, companies, and corporations.

Section 2: "All railroad companies, including street railways, whether operated in one or more counties; all sleeping car, dining car, drawing-room car and palace car companies, all refrigerator, oil, stock, fruit, and other car-loaning, and other car companies, operating upon the railroads in this State; all companies doing express business on any railroad, steamboat, vessel, or stage line in this State; all telegraph and telephone companies; and all companies engaged in the transmission or sale of gas or electricity shall annually pay to the State a tax upon their franchises, roadways, roadbeds, rails, rolling stock, poles, wires, pipes, canals, duits, rights of way, and other property, or any part thereof, used exclusively in the operation of their business in this State, computed as follows: Said tax shall be equal to the percentages hereinafter fixed upon the gross receipts from operation of such companies and each thereof within this State. When such companies are operating partly within and partly without this State, the gross receipts within this State shall be deemed to be all receipts on business beginning and ending within this State, and a proportion, based upon the proportion of the mileage within this State to the entire mileage over which such business is done, of receipts on all business passing through, into, or out of this State.

"The percentages above mentioned shall be as follows: On all railroad companies, including street railways, four per cent; on all sleeping car, dining car, drawing-room car, palace car companies, refrigerator, oil, stock, fruit, and other car-loaning, and other car companies, three per cent; on all companies doing express business on any railroad, steamboat, vessel or stage line, two per cent; on all telegraph and telephone companies, three and one-half per cent; on all com-

panies engaged in the transmission or sale of gas or electricity, four per cent. Such taxes shall be in lieu of all other taxes and licenses, State, county, and municipal, upon the property above enumerated of such companies except as otherwise provided in section fourteen of article thirteen of the constitution of this State, and as provided in section twenty-two of article four of said constitution.

"The word 'municipal' as used in this act shall apply to incoroprated towns and cities formed under article eleven of the constitution of this State and to none other."

The preparation of reports required by the State Board of Equalization entailed a great burden upon the companies coming within the law and the 4 per cent of gross receipts assessed to gas and electric companies has added materially to the total taxes paid. The total receipts of these companies in California for the year ending December 31, 1910, was $30,458,313, producing over $1,200,000, over 10 per cent of the total amount of taxes raised for State purposes.

On September 1, 1911, Senate Bill No .14 passed by the Legislature went into effect, relating to the liability of employers for injuries or death sustained by their employees, providing for compensation for the accidental injury of employees, established an industrial accident board to be appointed by the Governor, making an appropriation therefor, defining its powers and providing for a review of its awards.

The terms of this Act are yet optional so far as assuming the fixed basis of compensation is concerned. The act fixes the amount to be paid in all cases from slight injuries to death. (But nothing is allowed if the period of disability does not last more than a week.) All disputes between injured workmen and their employers are to be adjusted by an "Industrial Accident Board" to be appointed by the Governor. Appeals lie to the Superior Court and then to the Supreme Court, but only as to the question of fraud and to the sufficiency of the facts to support the findings of the Board. All such appeals are to be given preference on the court calendar. But whether accepted or not, the old defenses of contributory negligence, assumed risk and negligence of fellow servants, are repealed. In other words, if an employer chooses to place himself within the act, his responsibility and damage are clearly determined thereby; if he does not, he must defend himself in ordinary actions at law, but without the defenses above named, and without limit as to how much a jury may award in damages. The only negligence of the employee which will bar recovery is "willful misconduct."

At our next election in October, an amendment will be placed before the people to remove the optional phase of the act, and make the acceptance of the fixed compensation compulsory. This form of legislation has become popular, not only in California, but in many other States. There is no doubt that all concerned would be greatly benefited by regulations which would procure for the injuried a larger portion of the amount paid by the employer. At present, much less than 50 per cent reaches the injured. The balance is consumed in expenses. Much anxiety has been felt by employers on account of the act; but just how great a burden it may prove to be is yet to be demonstrated.

At our last meeting President Cline called attention to the desirability of a Public Service Commission for the State of California along the lines of those established by other States. Two amendments to the consideration have been approved for submission to the people in October—Assembly Constitutional Amendment No. 6 enlarging the number of Railroad Commissioners to 5, and Senate Constitutional Amendment No. 47 enlarging the powers of that Commission. This makes it optional for cities by majority vote to retain unto themselves the right to regulate public utilities as heretofore and also to recover such right even after it has been surrendered to the State Railroad Commission.

It is to be regretted that California cannot have a Commission with complete control similar to the other progressive States where so much has been accomplished. The State of Nevada has adopted and is now working under a Public Service Commission very similar to the Wisconsin Commission and, although its field of labor is limited, it is handling the problems in a progressive manner.

The absolute necessity for such a Commission is demonstrated in Los Angeles's experience. Their Local Board of Public Utilities clothed with extraordinary powers, was repudiated by the City Council in its desire to meet with popular approval after exhaustive investigation and report by high-priced experts.

The settlement of the San Francisco Rate Case by compromise has disposed of the most important litigation of interest to gas men. There have been many minor cases of damage, etc. The California District Court of Appeals, 115 Pac. 754, Fair vs. Nome Gas & Electric Company, has sustained the findings of the Lower Court upholding the provisions of Section 629, California Civil Code, regulating the furnishing of service when the consumer is within 100 feet of the main.

The labor situation, so far as the gas industry is concerned, has been very satisfactory during the last year. The wonderful growth of all the cities on the Coast has required very extensive construction work, keeping large numbers of men employed during the entire year. While the agitator is always with us, I believe there exists a better feeling between the gas companies and their men than in almost any other calling.

Pursuant to instructions given at the last convention, a committee was appointed for the purpose of arranging for the Congress of Gas Men to be held in San Francisco during the Panama-Pacific Exposition in 1915. Invitations to participate have been sent to the General Associations and I believe a continuance of our effort will result in the greatest gathering of gas men ever convened.

At this time I wish to thank the officers of the Association for their hearty co-operation during the year, and especially in preparation for this convention. I also desire to thank those who have generously given their time in the preparation of the papers to be read before this meeting. Subjects of most vital importance are before us and I trust that all present will take an active part in their discussion.

THE GAS METER.

BY W. M. DU VAL.

I want to begin by saying that I am indebted to Mr. William McDonald of Albany, N. Y., for much of the data contained in this paper.

From the time James Murdock in 1792 first manufactured gas for commercial, or as King says, for economical purposes, until about the year 1820, there was no way of ascertaining how much gas was used, excepting by counting the number of burners used and guessing at the amount each burner consumed per hour, or some other period.

This proved a very unsatisfactory way of selling gas, as the unscrupulous consumer always got the best of it, and the honest one the worst, and it is a fact that until some method of measuring gas was obtained all attempts to sell gas commercially were financial failures.

So those engaged in the manufacture and sale of gas soon realized the necessity of securing some instrument that would inform them how much was being used, and set themselves seriously to accomplish what must have seemed to them an exceedingly difficult task.

It is not the intention here to undertake to describe the mechanical details of these first attempts at meter making, as they are fully described in King's "Treatise on Coal Gas," and so far as wet meters are concerned, in a paper on Station Meters by Mr. Donald McDonald, of Albany, N. Y., and read at the Congress of Gas Associations in June, 1904.

It may be said briefly, however, that, spurred on by the necessity for a measure of some kind, Samuel Clegg early in 1815 made the first known attempt to make a gas measuring machine. It was a crude attempt and would not work practically. His second attempt was made in December, 1815, and he succeeded so far as to have his measure styled "The First Gas Meter." In 1817 and 1818 Mr. John Malam greatly improved Clegg's meter, and it was again improved and made practical by Samuel Crosley, who became possessed of Clegg's patents in the year 1819 or 1820.

In 1820 the manufacture of wet gas meters was commenced and carried on as a regular business, and the sellers of gas gradually began their use. As an illustration of conditions, I quote the following from the prospectus issued by the Edinburgh Oil-Gas Light Co. in 1824:

"The directors of this company beg leave to announce to the inhabitants of Edinburgh, that they will be ready early in November next, to supply them with a light, which, for brilliancy, cleanliness, and economy, has not yet been equalled."

"To suit the convenience of customers, they have resolved to supply them with meters, through which all the gas passes, and is registered with the greatest accuracy. By this plan the consumers can be charged for no more than the exact quantity consumed, whatever may be the number or description of lights employed by them. Neither are they limited in point of time, but may use the light for a longer or shorter period as best suits them, and may increase or diminish the quantity at pleasure."

The first dry meter was patented by John Malam in 1820, but it did not prove to be of any practical value, and apparently no further attempt was made to secure a dry meter until 1833, when an American named Bogardus, of Baltimore, invented a dry meter which was patented in England by Mr. Bery. In 1836 this same Bogardus invented another machine intended to be a dry meter, but it apparently was never completed. An Englishman named Edge became the owner of Bogardus's first patents, and very much improved the meter, and sold the rights to The Dry Meter Co., London, who made an attempt to manufacture it for sale, but apparently they never succeeded in getting it on the market, as they abandoned its manufacture in a comparatively short time.

About this time Mr. Defries invented what has been known since as the three diaphragm round meter, and eventually a large number of these meters were made and sold, as many of the companies on the Pacific Coast know. The diaphragm used in these meters was, and is still known as the "Defries diaphragm," and up to the time of its invention and manufacture was altogether the best dry meter that had yet been made.

King says that it is not an exaggeration to say that Mr. W. Richards stands in the same relation to the dry meter that John Malam does to the wet. He made it a measuring instrument insuring more regularity in its action and greater accuracy in its registration than any that had been previously made. This meter, which is the two diaphragm meter, was invented by him in conjunction with Mr. Croll in 1844, and with some modifications is today the meter most largely used for measuring gas.

Before leaving the subject of wet meters, however, it should be noted that nothing has ever been evolved that would satisfactorily take its place for certain purposes. As a station meter at the gas works, as a philosophical instrument in the laboratory or photometer room, its place is practically undisputed.

Made as it is entirely of metal on the principle of a screw and charged with water to such a height as to make the meter operative, it constitutes an exact measure, which King truly says, "May be placed among the most beautiful of mechanical inventions," and which as he suggests, establishes an imperishable monument to the names of Samuel Clegg, John Malam, Samuel Crosley and William Parkinson. To these names must now be added the name of C. W. Hinman, of Boston.

Mr. Hinman's achievement was not so much in the line of evolving an original principle in measurement, as it was in the application of the principles which Clegg and Crosley had laid down, but he perfected these principles to such an extent as to constitute original invention along the line of utilizing to a greater extent than ever before the cubical contents of the casing of the meter, and by his arrangement of measuring partitions a drum revolving at a periphery speed at a given loss of pressure not heretofore possible. This invention has been so successful as to make station meters built under his patents practically part of the standard specifications for a gas works in this country.

While the dry meter was invented by Richards and Croll, and manufactured by them, yet it seems to have been Mr. Thomas Glover who improved and simplified and put on the market large quantities of this well-known dry gas meter, and it is known today as the "Glover Two Diaphragm Slide Valve Meter." While many improvements in methods of construction have been made in the past fifty years, the mechanical principles of this meter have proved to be sound and it stands as the best exemplification of a practical consumer's meter, and will probably so remain for a long time to come.

Especially in the past forty years there have been many attempts made to produce measuring devices that would be superior in some features at least, or an improvement upon the two diaphragm slide valve meter, but the writer believes that it can be safely said that no one has yet succeeded in accomplishing this, and it is the opinion of the writer, gathered from as many sources of knowledge on this subject as has been possible for him to reach, that the two diaphragm slide valve meter in a tin plate case will continue to be used for many years to come to measure the great volume of gas made and sold for domestic purposes.

Wet meters had been in use for some time on this side of the Atlantic, when Defries and Richards brought out their dry meters in England. Before relating briefly the story of the making of the first meters in this country, it may be said, that, in a general way the gas companies here found themselves confronted with the same problem that the English gas makers had encountered, in that it was necessary in order to make a financial success of the business, to find some accurate means of determining the amount of gas used by each consumer. At first the gas companies here as in England, attempted either to manufacture their own meters, or were more or less financially interested in the enterprise, but this relation was soon discontinued for the same good reasons that gas companies do not today engage in the business.

The relation between the gas company and its consumers has always been one that required diplomatic handling, and the manufacture of its own meters by the gas company was, and is, inadvisable, if for no other reason than the obvious one that the gas company's position is strengthened by being able to state that the meters by which the consumer's indebtedness to the company is ascertained, are made by disinterested parties, and the consumer may, therefore, be satisfied that the determination of the amount of gas consumed is correct. So, while a few of the early gas companies did, for a time, make some meters, the practice was soon discontinued and the manufacture of meters was begun independently of the gas companies, and has so continued up to the present time.

Not the least of the pleasures of reading history or studying the record of the accomplishments of the past, is to find some reference to scenes or incidents which occurred in localities with which the reader is familiar, and particularly when such reference leads to places with which the reader is, or has been intimately associated. Especially is this true when the reference brings back thoughts of home to him who has wandered far in search of success.

So the writer knows he will be pardoned when he states that it was of peculiar interest to him, proud as he is of his Maryland birth and rearing, to find as he browsed among the early records of gas making in this country, that the first practical meter makers in the United States were located in Baltimore. The names of the men who started this enterprise are almost forgotten, and the little shop in Concord Street has long been closed, but inquiry on the writer's part developed the fact that meters bearing the badge of Slaney and Collier, or the Phoenix Meter Co. occasionally turn up in an odd lot sent in for repairs.

Mr. H. C. Slaney contributed a paper to the meeting of the American Gas Light Association in Washington in 1894, in which he gave some details of the early Baltimore meter makers. The first meter was made there in 1832 by James Hill, and he was followed by Mr. John Rogers and by Mr. John M. Slaney, whose son afterwards took in Charles Collier as partner and started the shop in Concord Street in 1848. This partnership was merged into the Phoenix Meter Co., which was liquidated in 1859. In the meantime, and, in fact, shortly after meters had been made in Baltimore, meter making had begun in other eastern cities: in 1836 in New York; in 1837 in Philadelphia; in 1849 in Boston, and in 1855 in Albany.

That there was considerable competition in the business even in this early day would be indicated by the following extract from a paper contributed by Mr. Donald McDonald of Albany, under the head of "Meters and Meter Makers" in the semi-centennial issue of the American Gas Light Journal in 1909:

"In the first issue of this Journal, of which this number is the semi-centenary, there appeared the advertisement of two firms of meter makers; that of Samuel Down of New York, and of Code, Hopper & Gratz of Philadelphia. In Mr. Down's advertisement appears the following paragraph which, read in the light of today, has in it a considerable element of humor. After assuring his prospective customers of the high quality of the meters which he is now producing, he continues with these words: 'He deems it highly necessary to place gas light companies throughout the Union, British Provinces, South America and Cuba, on their guard against all parties who are industriously endeavoring to introduce to their notice patent dry gas meters constructed precisely in imitation of his, but with Chinese-like characteristics, not fully understanding the correct principles upon which they are made.'"

It is not within the scope of this paper to attempt to follow the fortunes of these early establishments, or of the men who were associated with them except to note that these men have been among those best known in gas circles, and many of them have contributed in no small degree to the substantial progress of the gas business both on the engineering and on the commercial side.

It seems proper that some reference should be made to the subject of prepayment meters, and in looking into this subject the writer finds that the first mention of such a device in the patent office was in 1889, when R. W. Brownhill secured three patents

in this country on a device which he had previously patented in England and in Germany, and which he styled "An Apparatus for Vending Gas." He was quickly followed by Charles Middlebrook, with further patents by Brownhill, and then by Sawyer and Purves, W. Cowan, Damel, Orme, G. Carter, J. Hawkyard, J. Gowe, W. A. Thompson, W. N. Milsted, R. T. and J. G. Glover, and a few hundred others too numerous to mention, two of them being here in California.

The practical manufacture of prepayment meters began in England in 1891 and proved successful almost from the start. The writer is informed that the first prepayment meters sold in this country were made by the American Meter Co. under Parkinson's patents in 1893, but did not prove very successful. Like all new things that succeed, the prepayment meter was a development, and out of the large number of men who tried to invent, or perfect a device for the purpose, only a very few succeeded in making a prepayment meter that by its simplicity and durability commended itself to the gas companies as a satisfactory article. After the first years of experiment and with the discarding of innumerable devices that proved to be useless, two or three types of automatic, or as we call them, prepayment meters, came to be recognized as standard articles on the market, and the prepayment meter has proved to be a great help in obtaining consumers, especially among the middle and poorer classes of people, and there are today a very large number of such meters in use. In a considerable number of smaller manufacturing towns, particularly in New England, the local gas company has a greater number of prepayment customers than any other, and the writer notes in the reports given in Brown's Directory for 1911, that in one New England city the number of meters in use is given as 2,170, of which only 30 are not of the prepayment type. The writer believes that it can safely be said that the consumers that are supplied with prepayment meters are as a class the best satisfied of the gas companies' customers.

I will also refer to the "Complaint" meter, first made by the Maryland Meter Co. of Baltimore, I think about 1890. This meter is so constructed with Seth Thomas Clock as to show clearly to any consumer the amount of gas consumed during each hour, day or night, and is a "shelter in the time of storm" to clerks in the office of many gas companies.

In preparing this modest paper, which the writer looks upon as as a little sermon on the subject with which he is most familiar, he cast about for a text, and he found it in a society magazine under the head of definitions, in which the gas meter was defined as near as memory recalls, as an instrument designed to encourage matrimony by inducing economy in illumination, and to discourage daily baths. Probably the writer of this epigram had no thought beyond that of gaining a smile by taking a fling at a favored target for ridicule, but to the writer there was contained, in this semi-humorous remark, a text that furnished food for thought. It is quite unlikely that to either the ingenious Malam or the industrious Clegg did the thought occur that the meter, which they so patiently tried to perfect so that it would prove to be an accurate measure, would have any relation to the cleanliness of the nation, or, to carry the thought a little further, on the preparation of the world's food supply, and yet such is the case.

The gas that is measured through meters that are the evolution of the creation of Malam and Clegg is largely used to not only light the dark places, but to cook the breakfast, and often times the dinner and supper, of the better part of the civilized world. Yet more, even where civilization has elapsed into the almost barbaric splendor of the lobster palaces of the Great White Way, do we find the Bunsen Burner roasting the canvas-back duck or broiling the toothsome sweetbread, and the more modest highways are dotted with the dairy lunch with the gas heated griddle cooking flapjacks for the million.

And as for baths, the meter man can hardly supply the demand for meters for the measurement of gas sufficient to keep the household comfortable and in hot water. Indeed, a little reflection will show that when the sarcastic writer referred to the meter as a deterrent of bathing, he unconsciously struck a cord that covers the gamut of gas making from 1816 to 1911.

The Pacific Gas & Electric Company, which of course includes our friend Mr. Leach's division here in Oakland, advertise themselves as the "house of courtesy" and this concern is managed by men of well known truth and probity. This claim of theirs will not be denied. But what factor in their whole working corporate body is most conducive to this happy relation between them and their customers? Is it not the correct meter?

MECHANICAL HANDLING OF CARBON BY-PRODUCT OF THE OIL GAS PROCESS.

BY D. J. YOUNG.[1]

The carbon by-product of oil gas manufacture has long been the bug-a-boo of the oil gas engineer. This is a material of undoubted value which, instead of being an asset, has ,on account of the cost of recovery, become almost a liability. Several methods have been devised for handling this carbon, which, on a small scale, were fairly successful, but, when applied on a large scale, they were costly, occupied valuable ground space, and did not give the satisfaction which they should. The large amount of gas which the Los Angeles Gas & Electric Corporation was making, the very high value of land in the neighborhood of our plant, and the fact that the former method was unsatisfactory, forced us to give the matter a most careful study, and now we have a plant which I believe has solved the problem.

Without taking the time to detail the experiments, both successful and unsuccessful, which we have made, I will describe the essential features of our equipment for handling this by-product from the time it leaves the wash-box of the generator until it is in a finished form, and I wish to call particular attention to the fact that at no time need it be handled except mechanically. Portions of this plant are not yet completed, but the first installation has been in regular operation for some time and has demonstrated that the principles involved are correct.

[1]Superintendent of Gas Manufacture, Los Angeles and Electric Corporation.

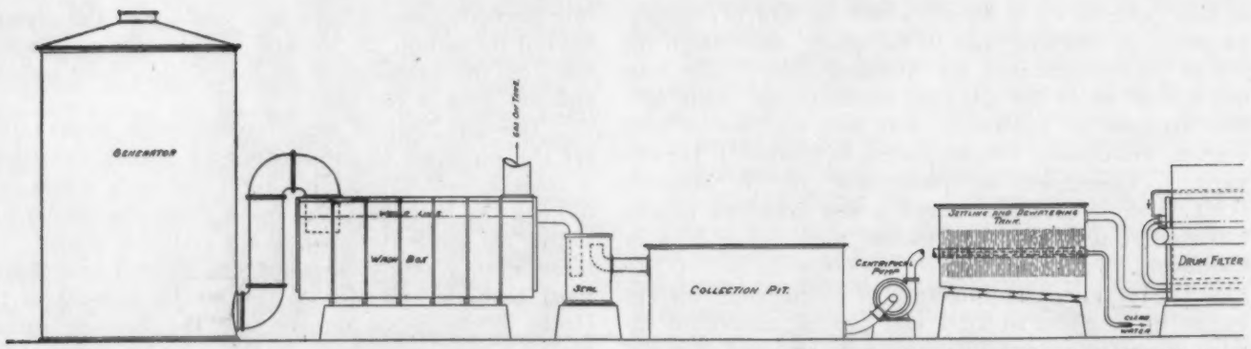


Diagram Showing Mechanical Handling of

From the wash-box the water, which contains the carbon, goes into a seal pot near the operating board of the generator, which seal over-flows through flumes of pipes into a pit, the pit caring for the water from all the generators. The water contains from 1 per cent to 2 per cent carbon. From this pit it is pumped by ordinary centrifugal pumps to our carbon plant, which is located about 2000 feet from the pump house. These centrifugal pumps give excellent service. The water is delivered from these pumps into settling tanks, installed in duplicate to admit of cleaning.

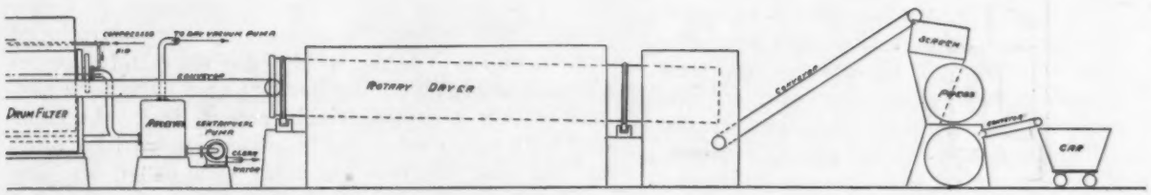
In these settling tanks two operations are performed. First: all heavier particles, such as standpipe carbon, ashes and balls of tar are precipitated to the bottom. Second: a portion of the water is removed.

There are two methods for removing the surplus water. Each is essentially a canvas filter to remove a portion of the water, leaving the balance of the water and the carbon in the tank, with suitable means for keeping the carbon from packing on the canvas and stopping the water from being drawn through. One of these is a leaf filter, similar to those common in the cyanide process, and the other is a pan-cake or disc filter, which is also adapted from the metallurgist. By these methods we remove from 50 per cent to 75 per cent of the water, but sufficient water is left with the carbon so that it is fluid and can be easily handled by the following apparatus. From the settling tanks the carbon is taken into a continuous drum separator. I will describe this piece of apparatus a little more fully, as it is the most important feature of our process.

Briefly this separator may be described as a drum with open ends 11 ft. 6 in. diameter by 16 ft. 0 in. width of face supported on a horizontal axis in a tank, and partially submerged in the liquid or pulp to be filtered. The outer surface of the drum is divided into longitudinal sections and covered with a filtering medium. Vacuum is applied to the sections and as the drum revolves, a cake of carbon forms on the surface. As the sections leave the liquid the cake is dried by the air being drawn through. Just before any one section enters the liquid again, air under low pressure is admitted to this section and the cake of carbon is discharged over a scraper or apron resting on the drum. The cycle is then repeated, the whole operation being continuous and automatic.

The following is a detailed description of the separator: The periphery of the drum is built of redwood staves firmly bolted to cast iron spiders with steel arms, and is made absolutely water tight. The outer surface of the redwood staves is divided into a series of shallow compartments or sections with their dividing partitions running parallel to the shaft. In each section is a grating of grooved wood strips on top of which is fastened galvanized wire screen, which serves as a firm, smooth backing for the filter cloth. This cloth is made in one sheet large enough to cover the whole drum and is stretched tight, being held in place on the ends by rope calked into a groove cast on the ends of the spiders. To protect the filter cloth from wear, to hold it in place and to act as a guide for the scraper, No. 14 galvanized steel wire is wound tightly around the drum, spaced about ¾ in. pitch. A thin steel scraper which serves to remove the dried carbon, rests on this wire, and is thus kept very close to the filter cloth without touching it.

Each compartment is connected to the vacuum receiver and to the compressor by two sets of pipes which are carried radially to the shaft, and then pass in two concentric circles through the trunnion to the automatic valve. This automatic valve consists of a flat valve plate or seat into which are screwed the vacuum and compressed air pipes leading from the various compartments in two concentric circles of 12 ports each. The valve proper is stationary and consists of a cast iron chamber which is ground to fit the valve seal. In the face of the valve is cut an annular slot or port, which registers with the outer circles of holes. Into this slot is fitted an adjustable bridge, which is long enough to at all times cover one port in the valve seat, in this way cutting off the vacuum from one section of the filter. The valve is held against its seat by atmospheric pressure and is prevented from turning by an adjustable valve stem. A single "blow" port is placed so as to admit compressed air through the inner circle of pipes to the section from which the vacuum has been cut off. By means of this valve, each section in succession is "blown" without affecting the remaining sections, the cake being thus released and the pores of the filter cloth cleansed at each revolution. The air and the water from the sections go to a vacuum receiver which is connected to the wet and dry vacuum pumps. The water is handled by a water sealed centrifugal pump, while the receiver is exhausted by a dry vacuum pump. The water which comes from both this separator and the disc or leaf filter is practically clear and can be used again or discarded, as the needs of the plant call for.



Carbon from Generator to Briquet Storage.

The carbon as delivered by this separator contains from 40 per cent to 50 per cent of moisture, and before being used, it must be further dried. We convey this carbon direct to a rotary dryer, very similar to a cement dryer I need not describe this, further than to say that it is a very satisfactory machine, easy of operation and presents no operating difficulties. I would note, however, that we get the best results from this dryer by the use of a pyrometer, the fire end of which is placed in the drying chamber, enabling us to maintain a regular heat and get a uniform product. The carbon is delivered from this dryer containing from 15 per cent to 20 per cent moisture. It is then carried by conveyors to a screen with about ¼ in. mesh, where the lumps are removed and the fine carbon is deposited into a bin. This bin feeds direct into the hopper of a briquet or brick press. This press is similar to an ordinary pressed brick machine, slightly modified for handling carbon. With these presses the carbon is made either into a brick form, for water gas or boiler fuel, or into a briquet for a commercial fuel. The briquets or bricks are carried away from this machine on a belt conveyor and delivered into cars, wherein they are carried to storage yards.

While the bricks or briquets as they leave the machine, are apparently very strong, they are not ready for use until they have been seasoned or air-dried. In air-drying the briquets we pile them from four to six feet deep and leave them from three to six weeks. This should be done under cover. The briquets as we make them are cylindrical in form, 2½ in. in diameter by 2¾ in. high.

There is only one particular feature of the briquet press that should be mentioned, and that is the use of a bronze mold box and dies, in preference to steel. On account of the very great pressure that is employed in the presses, the wear on a steel mold box and dies is very great, and furthermore, the steel rusts, which causes trouble on account of carbon sticking to the molds. With a bronze mold box and dies, there is no rusting, and consequently no sticking of carbon to molds, and the wear is much less.

Attached is a diagrammatic sketch showing each step in the process from the time the carbon is produced in the generator until it is ready to be used or sold.

The cost of handling carbon by this method is largely dependent on local conditions, but I will give of labor necessary. It is obvious that the cost of such items as pumping and conveying is dependent on the approximate capacities of the apparatus and amount distance and height the material must be moved, and under very advantageous conditions, this travel could be almost entirely by gravity.

The separator requires thirty horsepower to operate and the machine can be handled by one man. Its capacity is rated in gallons of water and not tons of carbon, one machine handling about 25,000 gallons per minute, and removing all the carbon therefrom.

We have two dryers, one of forty tons and one of about fifty-five tons per day capacity, figured on material as delivered at about 20 per cent moisture. Each used twenty to thirty horsepower and requires one attendant, using carbon or oil for fuel.

We have two briquet presses, each of four tons per hour capacity. It requires two men and about thirty-five horsepower to operate each. By changing mold box and dies, bricks can be made on these presses. We also have two brick presses, one of two tons and one of one ton per hour capacity. The storage of briquets and bricks is simply a question of location and can be arranged to be handled very cheaply.

While at present we use carbon for boiler fuel and water gas fuel, and manufacture briquets for sale as commercial fuel, our experience has proven that briquets for commercial fuel yield the greatest value per ton for the carbon, and therefore receive first consideration in our plant.

As to the market for briquets, this is also a local condition, but with the prevailing prices for coal on the Pacific Coast, the market should be easily established, especially in view of the admitted superiority of briquets over any other solid fuel.

The following is an average analysis of the briquets as delivered to our consumers:

Moisture	3.94%	
Volatile and combustible matter	11.41	
Fixed carbon	83.94	
Sulphur	.51	
Ash	.20	100%
British Thermal Units per pound	14,540	

Tests on carbon briquets, made according to United States Government specifications, for breakage, shows results which are very favorable compared with either coal or other forms of briquets.

RATES FOR GAS SERVICE.

BY C. L. CORY.

In all probability more money has been expended in the various States and cities of the Pacific Coast during the past decade, either directly or indirectly, in connection with litigation or other phases in determining the rates for gas service, than has been the cost, in the same territory, of all experimental and other related scientific and engineering work of improving the methods and reducing the cost of the manufacture, distribution and sale of gas. Certainly, there is no problem connected with the gas industries more important than that of rates. There is a spending and receiving side to every organization. It is the difference between what is spent to provide a commodity and the amount for which the commodity in the aggregate is sold which establishes the desirability of the business. Unlimited commendation is due the gas engineers of the Pacific Coast for the work they have done in recent years to improve the processes of gas manufacture, including all of the notable advances in high pressure distribution and improvement of service, as well as the increased economies and reduced cost of production. It is but natural, therefore, that we should be equally interested in the consumption and use and especially the proper rates to be charged for gas, not only from the standpoint of the manufacturing companies, but quite as much must the consumer's position in the matter be given due consideration.

*The term "public utility" has been defined as meaning and embracing each corporation, company, firm, individual and association, such as express, telephone, telegraph, sleeping car, freight-line, equipment, electric light, gas, natural gas, pipe line, waterworks, messenger, signal, union depot, water transportation, heating and cooling companies; street, steam, suburban and interurban railroad companies; also any plant or property owned or operated by such companies, corporations, firms, individuals or associations.

It is such companies as above indicated that provide service to the public, and the rates for such service should be based primarily upon the cost of providing adequate and satisfactory service. To determine this cost is many times a difficult task, and especially so when the devices and system required to provide the service are not fully developed and standardized. As an illustration, the rates for freight and passenger service between San Francisco and Los Angeles, whether by steamer or by rail, have been established for such a length of time that it is not a difficult matter to decide upon the reasonableness of such rates, and, therefore, rates may be established that are more or less permanent and not subject to material revision from year to year. However, to determine adequate freight and passenger rates between these cities using the automobile or the aeroplane would be exceedingly difficult, if not impossible. However, it is not to be concluded that in future years, service, both passenger and freight, with the newest aerial devices for transportation may not become so well established, reliable and satisfactory that rates of service might not be readily determined.

The business of manufacturing and supplying gas has been very thoroughly standardized, although progress is constantly being made in the methods of manufacture as well as the increased economies in distribution. High pressure systems have been introduced in recent years. The methods of gas manufacture from California crude oil on the Pacific Coast have been perfected within a comparatively recent date. As compared with many other public utility enterprises, however, the gas business has been established so long that the determination of the cost of service is comparatively easy.

The cost of delivering gas to the consumer necessarily embraces the determination among other things of a fair valuation of the plant that is devoted to public use, the gross earnings under any given set of rates and the reasonable operating expenses when depreciation of the physical property and adequate returns on the investment are included.

The general information necessary in order to arrive at the proper rate for gas service may, in general, be subdivided as follows:

1st. The valuation or appraisal of the plant used for the manufacture and distribution of gas.

2d. The annual cost of operation, including a complete segregation of all accounts set forth in such a manner as to indicate the different operating costs per 1000 cubic feet of gas manufactured and sold.

3d. A statement of the quantity of gas made and sold for a number of years, preferably not less than five, and the total revenues received each year from the sale of gas.

Valuation.

There are a number of fundamental principles involved in obtaining the valuation of a gas plant and system to be used in determining a proper rate for gas service. It is quite as important that corporations themselves should determine for each year the valuation of the system upon which a return on the investment is to be earned as it is for this valuation to be determined by any public body, whether only incidentally or directly concerned, with the fixing of rates.

The original cost of construction, the cost of reconstruction or reproduction new, the cost of reproduction new less depreciation, the present value, the assets and liabilities taken as a whole, the capitalization, the bonds and stock outstanding, and the gross earnings and operating expenses are all elements that should be considered in determining the valuation of a public utility for rate fixing or other purposes. Each of these elements constitutes evidence of what is a fair value. The original cost, the cost of reproduction new and the present value bear a very close relation to the physical property of the plant and are, therefore, most usually considered of the greatest importance in determining the proper valuation. Which of these three elements gives the best indication of the value will vary in each individual case.

The original cost can, if all records of construction are available, be usually determined by what is known as the historical method. The conditions

*Laws of Ohio, Langdon Act, 1910, Page 429.

under which the construction of the system was carried out, whether all done at once or extended from year to year as the growth of the business required, will be covered in this method of determining the original cost. When proper charges only are included and no mistakes have been made, for which the builders may be properly held responsible, the original cost represents the investment that has actually been made in the physical property of the plant.

The rapid growth of many systems, however, and the rapidity with which changes have been made, coupled with inadequate records, make it many times practically impossible to determine the original cost with any degree of reliability. Much depends upon the manner in which accounts and records have been kept. In order to be of value they should show the actual cost of the different parts of the plant, segregating labor and material, the cost of engineering superintendence, management, and administration, the amount that has been allowed as interest on the capital during the construction period, the cost of financing, which will include the discount at which bonds were sold, the basis upon which stock has been issued or sold, all promotion expenses and similar items. It is not difficult to imagine records which would give the above information, but I venture to say that most rare is it that the original cost of a gas plant operating at the present time may be obtained entirely in such a complete and satisfactory manner.

Moreover, the original cost even when determined in full detail may not be the valuation upon which reasonable returns should be allowed. It is a question of equity between owners of the plant on one hand and the customers on the other. The owners are entitled to a reasonable return upon what they have invested, while the customers should not pay rates for service that will yield more than an adequate return upon the investment necessary to supply such service. If the plant has been built when prices were abnormally high and money has been lost through lack of reasonable skill, excessive promotion fees and discounts, private understandings between the builders of the plant and the contractors, the original cost may be decidedly greater than the valuation on which the investors should be allowed to earn.

Conversely, it may be that the plant was constructed when the prices for labor and material were excessively low, or a great portion of the plant may have been obtained through failure of previous owners to successfully carry on the business, due either to temporary financial difficulties or what has been more common, great strides in the method of manufacture, resulting ultimately in foreclosure. In such a case the original cost would hardly be a fair figure upon which to base the valuation for rate fixing purposes, as the foresight and enterprise of the present owners certainly justifies some regard.

The original cost is so rarely available that the cost of reproduction new of the plant usually must be determined. A great deal of engineering knowledge and detail work is necessary to obtain this result. Invariably, a complete inventory of the physical property is the first step required. The only satisfactory inventory is one obtained as a result of actual inspection and enumeration, aided, as much as possible, by all the records available, and supplemented by such additional information as may be had from the various heads of departments and other employees of the company. Such an inventory should include for each different part of the property the amount of labor and material required to provide ready for operation each element of the completed plant. The next step consists in obtaining from all data obtainable a suitable price per unit, not only of each element of the property, but the labor and material required to install the devices in position ready for operation. It is well in determining such unit prices to take a period covering at least five years and obtain the average in this manner. The total and average cost of the labor and material that has entered into the plant ready for operation is thus obtained.

Inventories.

Inventories of the actual physical property which taken together go to make up a modern gas plant and system should include the following:

Real estate.
Buildings.
Gas works, including holders.
Street mains.
Services.
Meters, regulators and lamps.
Furniture and fixtures.
Automobiles, motorcycles, etc.
Stable equipment.
Tools.
Supplies.
Working capital.

Real Estate.

A complete list of all real estate used wholly or in part for the purpose of the manufacture and the supplying of gas should be included in the inventory. The values placed upon this real estate should be determined in so far as possible by actual sales of property in the vicinity of the real estate in question when used for a similar purpose. The purpose for which the property is used must always be taken into consideration. Disinterested real estate men are usually able to give information leading to a rational decision in such matters. Unfortunately, assessments for taxation purposes are not of material assistance in appraising such real estate. On the other hand the actual figures at which adjacent property is sold are rarely available.

When a gas company has real estate not actually in use but is holding it for future occupancy the question naturally arises should such real estate be included in arriving at the valuation of the plant for the purpose of determining the proper rate for the sale of gas at any given time.

In arriving at a conclusion in this matter, it is best to proceed upon the principle that it is proper to include all property actually required and used in the carrying on of the business at the time in question and not to include such real estate not required or used on the date the valuation is made. However, at some later period when the real estate is actually put to use and occupied by buildings and equipment, that are a part of the operating system, in arriving at the valuation, there should be added interest and taxes during such time as the investment in such lands has been tied up but not productive. On any other principle, customers of today would pay a rate for serv-

ice in excess of what they should and customers of the future may pay relatively less and thereby benefit unduly.

Buildings.

All of the buildings owned by the company as a part of its operating system should be included in the inventory and so segregated that it will be possible to separate the structures such as office buildings, etc., from the structures required as a part of the manufacturing plant. This should be done in order to obtain the cost of the manufacture of gas as delivered to the holders separate from the general expenses connected with the operating of the property usually connected with the expense of the general offices of the company. The inventory costs of all buildings are usually best obtained from the plans, specifications and contracts or other records of the company. The condition of the buildings in general usefulness and probable future life should be taken into consideration in determining the probable value based upon original cost, cost of reproduction new and present value.

Gas Works.

The gas works inventory must include besides buildings all of the equipment necessary in the manufacture, metering and storing of gas, such as boilers, blowers, compressors, generators, exhausters, holders, heaters, pumps, piping, purifiers, scrubbers, and miscellaneous equipment. The date of purchase or contract and the date when installation was commenced and completed as well as the type of apparatus and by whom manufactured, should be included as a part of the inventory. When possible, the cost of each element of the entire manufacturing plant ready for operation segregating labor and material is desirable.

Street Mains.

An inventory of street mains is best obtained by tabulating and mapping from work reports all installations and removals for as long a period as records are available. Scaling street mains from maps in order to obtain the aggregate length of the various sizes should only be resorted to when the actual records of installation are not available. The size of all street mains including fittings and accessories of every character and classified as to the material used, such as wrought iron, cast iron or casing, should be included in the inventory. In a similar manner the cost of replacing the street surface in the various kinds of paving should be determined from the most recent records available for such work.

The item of paving in determining the value of underground street mains and services has been variously considered. Every legitimate expenditure in adapting the utility to the progress and community growth, even if this involves the removal of the plant from one locality of the city to a distant and more remote location, is a proper charge to construction. All expenditures for putting down pavement by the company as required by the city or the cost of cutting through such pavement for extensions and construction purposes, and its replacement, are unquestionably proper capital charges. However, it is a question whether a gas company may properly capitalize the expense of municipal betterment which it has not borne and when such benefits to the gas company are only incidental and can only exist from the standpoint of the cost of actually reproducing their underground system, after the street has been paved, when as a matter of fact the existing underground mains and services were laid before the paving was actually put down. The cost of such paving is not a proper element of value when the cost of laying such pavement has not been paid for by the gas company nor any expense incurred therewith, providing of course that all costs borne by the company of changing the grade or depth of underground mains and services, in order to adapt them to conditions required for paving by the city, are included in the capital account.

Services.

In obtaining the inventory of services, it is most satisfactory to list all services, obtaining thereby the size, length, and character of each service as shown by the records of this department. Only that portion of the service belonging to the company should be included and if consumers have paid for any portion of the service that portion should be considered as belonging to the company. The total value of the services should represent only those actually owned by the company and in general should not include any services or reproduction of any services within customers' premises unless the cost of the same has actually been met by the company.

In order to arrive at a unit cost of services, it is best to obtain the actual labor and material charge for a number of services installed in various parts of the district served and at different seasons of the year, to get a reliable average cost per unit length of service.

Meters, Regulators, Etc.

The inventory of meters in service is usually readily obtained from the company's records. The inventory cost of the meters should include the necessary testing, painting and all storeroom expense. The cost of installing the meters should include all costs from the time the order leaves the general office until the order and record of installation are returned to the general office. The time cards of meter installers covering a considerable period can with great advantage be used to determine the cost of installing meters of different sizes.

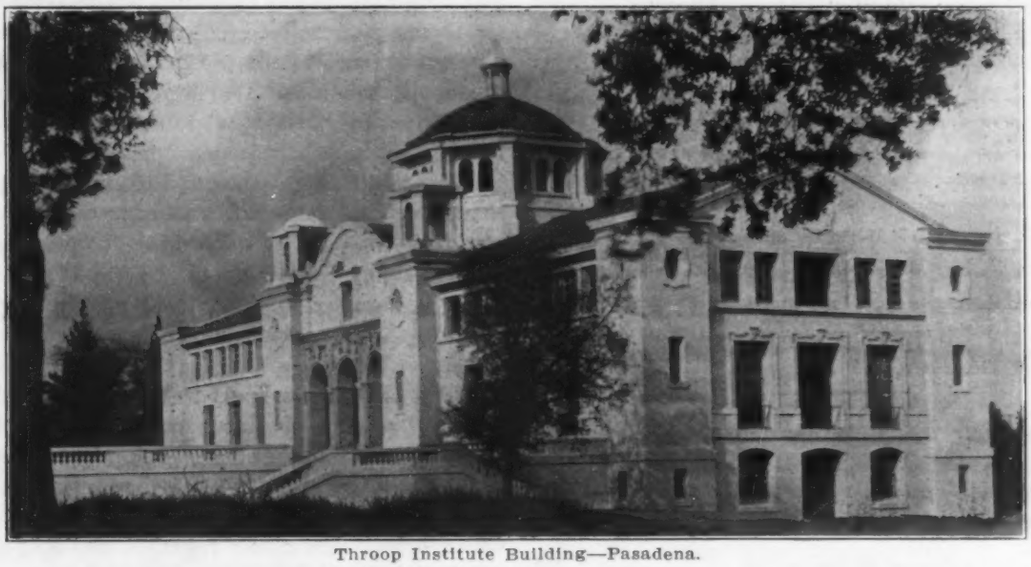
Furniture and Fixtures, Automobiles and Motorcycles, Stable Equipment, Tools and Supplies.

Complete inventories should be made of the property owned and in actual use by the company for the carrying on of the business covering all subsidiary items such as furniture and fixtures, automobiles and motorcycles, stable equipment, tools and supplies. Only those supplies should be included which are active and of the normal quantity carried in stock and necessary for the operation of the company's business.

(to be continued)

THROOP POLYTECHNIC INSTITUTE, PASADENA, CALIFORNIA.

Throop Polytechnic Institute will begin its next academic year on the 20th of September, when the offices will be open for entrance examinations. Registration will take place September 23 and 25, regular instruction beginning on the 26th. The enrollment will show a substantial increase over that of last session. Throop authorities are especially pleased with the character of most of the applications, which show an unusually good standing in the high schools from which applicants come, as certified by the respective principals. Of the high schools of Southern California, Los Angeles, San Diego, Monrovia, Santa Ana, Compton, Redondo, Banning, Occidental and Throop Academies, and the Pasadena High School, will be represented. Among the Pasadena Freshmen may be named Joe Beek, Raymond Call, Ayre Powell, Verne D. Elliott, Earle A. Burt and Robert S. Ferguson.



Throop Institute Building—Pasadena.

The budget for the approaching year shows an investment of several thousand dollars for new equipment, in addition to the large and valuable apparatus installed. The Institute easily leads the West in the character of its equipment in Electrical and Mechanical Engineering, while the Civil Department will be materially advanced as applications increase for that course. Friends of Throop continue to prove their devotion by generous deeds, the most recent benefaction being a gift of $25,000 made last week by a resident of Los Angeles. There are two residents of that city on the Board of Trustees, General M. H. Sherman and Dr. Norman Bridge, President. The Pasadena members of the Board in the order of seniority of service, are Dr. Everett L. Conger, Mrs. Robert J. Burdette, Hiram V. Wadsworth, Dr. James H. McBride, Messrs, Hazard Halsted and Arthur Fleming, Judge Charles J. Willett, Dr. George E. Hale, with Messrs. Charles V. Gates, James Culbertson, Henry M. Robinson, William M. Vedder, and John Wadsworth.

There will be several changes in the Faculty for the coming year. Dean George A. Damon will begin his active duties as supervisor of Electrical, Mechanical and Civil Engineering, while keeping in lively touch with the practical affairs through his management of the Bion J. Arnold Company in Los Angeles, which is at present engaged in the study of the transportation problems of that city. Professor W. K. Gaylord, who is spending a year at Berkeley, will be succeeded in the Chemical Department by Dr. William R. Flint, recently of Yale. Professor B. F. Stacey, of the department of History and Economics, will, by order of his physician, take a year off, his place being filled by Professor Charles E. Barber, formerly Associate Principal of Throop Academy and head of the equivalent department in that institution. The complete teaching staff will be as follows:

George A. Damon (B. S., in E. E., University of Michigan), Dean; Supervisor of Electrical, Mechanical and Civil Engineering.

Royal W. Sorensen (B. S. in E. E., University of Colorado), Professor of Electrical Engineering.

Lucien H. Gilmore (A. B., Stanford University), Professor of Physics.

Herbert B. Perkins (S. B., Massachusetts Institute of Technology), Civil Engineering and Mathematics.

Robert E. Ford (E. E., University of Minnesota), Mechanics and Hydraulics.

Charles H. Kicklighter (B. S. in M. E., Georgia School of Technology), Mechanical Engineering.

Frederick E. Beckman (Ph. D., University of Chicago), French, German and Spanish.

William R. Flint (Ph. D., Yale), Chemistry.

H. C. Van Buskirk (Ph. D., Cornell), Mathematics.

Charles E. Barber (A. M., University of Nebraska), History and Economics.

Clinton K. Judy (B. A., University of Oxford), English.

Arrangements have been made with the city management of the Polytechnic High School (formerly Throop Academy), by which instruction will be given there on Saturdays to Freshmen who have not had the advantage of polytechnic high school training before entrance, and the elementary shop work of the Institute will also be done in the same way, its own laboratories being reserved for the higher branches.

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POWER AND GAS

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Electrical Features Panama-Pacific International Exposition 261
By Hamilton Wright
Primer of Applied Thermodynamics 266
Pacific Coast Gas Association Convention 268
President's Address Before Pacific Coast Gas Association Convention 269
By Frank W. Leach, Jr.
The Gas Meter 271
By W. M. Du Val
Mechanical Handling of Carbon By-Product of the Oil Gas Process 273
By D. J. Young
Rates for Gas Service 275
By C. L. Cory
Throop Polytechnic Institute, Pasadena, California 279
Editorial 281
Helping One Another.
Throop Polytechnic Institute.
A City's Traffic Struggle.
Personals 282
Electrical Contractor's Notes 282
Industrial 283
Magnetic Chucks.
Motor-Driven Grain Mill.
Trade Notes 283
Book Review 283
News Notes 284

Helping one Another

It is typical of the struggle of life that when we have encountered obstacles on the road to success we want to make the pathway easier for the younger brother tediously treading after us. No higher make-up of the true man can exist than that of possessing an inner desire to help his younger brothers get a proper start in the work of life.

It was an inspiring sight when on last Tuesday morning the members of the Pacific Coast Gas Association raised in a few minutes over six thousand dollars as a donation to the University of California to assist in the starting of technical instruction looking toward a degree in gas engineering at the State institution. John A. Britton sprung the idea upon the convention and pledges began to roll in from all sides and, although but five thousand dollars were asked, over six thousand were pledged in less than fifteen minutes. The spirit back of the pledges was the inspiration to those who beheld it. The big corporations gladly gave their bountiful portion, while the young men of simple means spoke of their financial inability to pledge heavily, but said that they wanted to make the path easier than they had found it, and consequently wanted to pledge their portion, no matter how insignificant it might seem. Such acts of a great organization evidence its anxiety to properly prepare young engineers to solve the future problems of gas engineering on the Coast.

And all of this leads to comment on the general fraternal spirit of gas men on the Coast. No one can be present at their gatherings for but a few minutes without being impressed with that inexpressible something which pervades their meetings—that something which draws men closer together and forges a lasting bond of fellowship. How clear and true and earnest are their gatherings!

Beginning with the able address of President Leach, followed by the scholarly paper of E. C. Jones, on down the line, including the brilliant appraisement paper of C. L. Cory, and so on through the list of papers. All were intensely interesting and well-discussed. The striking feature of all was the deep-felt interest in the welfare of the convention by such men as L. P. Lowe, John Martin, and that father of all that is noble and good in our western life, John A. Britton.

It does one good to attend such gatherings. If anyone has a grouch or an inner pent-up feeling of a something that doesn't belong in his inner physical make-up, it certainly fades away at such a getting together as the Oakland convention of last week. All honor to those having the convention in charge.

Throop Polytechnic Institute

Elsewhere in these columns will be found an account of the fall opening of Throop Polytechnic Institute. The Journal has watched with intense interest the trend of affairs in Pasadena looking to the betterment of affairs technical. The high ideals set forth in the announcement of courses cannot but have a deep and far-reaching effect

in raising the standard of scientific and technical study on the coast.

With such broad-minded citizens to direct its destinies as Dr. Norman Bridge, Mrs. Robert Burdette, George E. Hale, and a dozen others, a brilliant future is without question. With such well-known engineers as George A. Damon and Ezra F. Scattergood, it would be difficult for the western youth to find better opportunities of absorbing engineering knowledge.

At first sight, the decreased enrollment due to the high standards decided upon, a small enrollment of thirty students, would seem to handicap affairs. Ah—but how different in reality, so far as opportunities presented the student to have personal contact with his instructor. Under this regime, the western idea of a friend as being a "person who knows all about you and likes you," is most strongly realized.

Situated in heart of a country of boundless energy —in the heart of a country that dreams dreams and makes good—it offers every inspiration for the shaping of future ideals. The nearness of the San Gabriel mountains offers unexcelled opportunities for hydro-electric study. It is to be hoped that some philanthropist may endow the Institute with sufficient funds to install a high pressure hydro-electric plant, and thus make Throop unique among the technical institutions of the world and symbolize its very existence as being in the greatest hydro-electric country in the world.

The Journal has every good wish for Throop and her struggle ahead. May she prosper, and above all may she ever cling to her high ideals!

A City's Traffic Struggle

Two issues back, the Journal commented editorially on the appointment of a traffic expert by the city of San Francisco to look into the problems pertaining to simplification of traffic in the great western metropolis. At that time we congratulated the authorities upon the securing of such an able engineer as Bion J. Arnold, past president of the American Institute of Electrical Engineers and one of America's most distinguished traffic experts.

We sincerely hope that Mr. Arnold will wade into the task ahead of him without fear, and that his recommendations will receive immediate approval and quick action on the part of the authorities having the matter in hand. In the mornings from eight to ten or in the afternoons from four-thirty to five-thirty, by the civilian, who tediously but safely threads his way across the overcrowded central districts of San Francisco, a just cause for the return of thanks to his Maker is deeply felt for his safe deliverance. The growth of the traffic difficulty during the past few months is almost appalling. While this traffic difficulty suggests congratulations upon San Francisco's business growth, it is evident that the confusion must be remedied at once or the welcome traffic will become paralyzed. It is almost pitiful to observe the commuter hasten to catch the departing ferry after completing the business tasks of the day. He hastens down market street observing ahead on the great ferry clock, but scant time to make connections. Wearily he dodges the automobiles flanking the great thoroughfares opening into Market street. Having arrived breathless at the big merry turn of car tracks in front of the ferry building, like the recent mermaids who swam the golden gate channel, he plunges in and amid the roar and din of cars, he looks around to catch his bearings, but—alas—there is no life-boat nearby to help him in case he falters. He must plough ahead. In the labyrinth of tracks encountered he might playfully imagine he is once more threading the maze at Del Monte, were a false step not so fatal. He makes one deep gasp for breath; then, with a supreme effort he comes in front of the ferry building only to have his nerves rent to pieces by the howling mob of newsboys peddling their daily mess of frightful accidents due to traffic congestion in our great cities. Finally, physically worn out, the ordeal of riding across the bay on an overcrowded, ill-ventilated boat, thence, by rail to his suburban residence is over, and no wonder his loving wife greets him with the remarks: "Why, John, you look so tired; you must'nt work so hard."

In January, 1910, Mr. Arnold made an extensive report on the traffic conditions of the city of Pittsburg. In the analyzing of the traffic conditions there, he compiled statistics covering fourteen of America's foremost cities. Among the data detailed were tabulations of passengers per car mile and annual earnings per car, and in both instances San Francisco's street railway systems outranked every other American city. Such figures of course should not be taken too seriously without going into every detail in their makeup. They do, however, indicate a healthy, prosperous condition of her great traffic companies.

While unquestionably the great traffic companies can greatly improve their present methods and thus clarify the congestion, the city of San Francisco, no longer an overgrown country town, should prepare to carry a large portion of the commerce of the world. Carefully selected expert officers should be detailed to direct the traffic at the congested centers as is done in Chicago, and more especially in Detroit. An overhead crossing at the Ferry is an immediate need, and the day for the elevated and perhaps the underground road to relieve and segregate the local from the suburban traffic is now at hand.

With a city and tributary population of nearly a million, new conditions are before the bay cities for their earnest and most careful consideration. Never before did a get-together policy mean so much as it will mean now. The recent announcement of the great Atlantic ocean-going companies that immediately upon the completion of the Panama canal, through service will be established from European ports via the canal to San Francisco, can mean nothing but an enormous influx of population. San Francisco—the bravest peopled city of the world—surely she'll be equal to the crisis!!

PERSONALS.

Henry F. Frosch is reported seriously ill at the German Hospital, San Francisco.

A. C. Paulsmeier, chief designer of the Byron Jackson Machine Works, has just returned to San Francisco from the East.

A. G. Wishon, general manager of the San Joaquin Light & Power Corporation, arrived at San Francisco last week from Fresno.

Melville Dozier, Jr., assistant manager of the Northern Electric Railway Company, was a recent arrival at San Francisco from Sacramento.

F. O. Sievers, of the sales corps of the Fort Wayne Electric Works, returned to San Francisco during the past week from a Southern California trip.

H. W. Crozier, of Sanderson & Porter's Pacific Coast branch office, has returned to San Francisco after a trip through the interior of California.

R. S. Buck, of the firm of Sanderson & Porter, who recently spent some time in Idaho investigating an irrigation project, has returned to New York.

B. T. Holtz, manager Northern Electric Company, Vancouver, is to be married September 26th at San Francisco. The Journal extends hearty congratulations.

T. C. Martin, executive secretary of the National Electric Light Association, was in attendance at the Spokane convention of the N. W. Electric Light and Power Association.

E. F. Scattergood of Los Angeles is examining various power equipments throughout the Northwest as suggestions for the electrical features of the Los Angeles aqueduct.

Messrs. Stafford, W. V. Cullen and John Alberts have joined the sales force of the Allis-Chalmers Company's San Francisco office under Fred L. Webster, the Pacific Coast manager.

A. B Saurman, manager of the Pacific Coast branch of the Standard Underground Cable Company, is expected to return to San Francisco about October 1, after spending a month in the East.

H. G. Aylsworth, manager of the Aylsworth Agencies, has returned to San Francisco after spending the past week at Los Angeles, where his firm has just opened an office under the management of W. R. Greene.

William Taylor, sales manager of the General Roofing Company, with headquarters at San Francisco, is now on one of his regular trips to the Northwest, and was in Tacoma recently looking after the interests of his company there.

A. W. Ballard, who is an officer of the Phoenix Gas & Electric Company of Phoenix, Ariz., and was at one time manager of the General Electric Company's Los Angeles office, recently motored up from Los Angeles to San Francisco.

W. W. Briggs, assistant sales manager of the Westinghouse Electric & Manufacturing Company, has returned to his San Francisco office after accompanying Sales Manager S. L. Nicholson as far as Los Angeles on his way to East Pittsburg.

Harris J. Ryan, professor of electrical engineering at Stanford University, California, is at Colorado Springs, Colo., in connection with his work for the Los Angeles aqueduct, for which he has been granted a year's leave of absence from his college work.

R. D. Holabird, of the Holabird-Reynolds Company, left last Tuesday for Seattle, where he has a branch electric supply house. He took with him as far as Portland the silver cup which he has won three times as a golf trophy and which is to be contested for again.

Frank R. Bates, of the engineering firm of Bates & Clark, Seattle, left for his old home at Eau Claire, Wisconsin, recently, accompanied by Mrs. Bates and the family. Mr. Bates has been extensively engaged in engineering work in the neighborhood of Baker, Washington, and now takes a well earned vacation.

J. H. Wallace, chief engineer of the Tidewater & Southern Railway, recently visited Turlock, where track laying has just been commenced on the 80-mile standard gauge electric road, which is to be built via Modesto to Stockton. Construction work will be pushed from both ends of the line.

Henry J. Pierce of Spokane, Wash., who is interested in local and suburban electric railways at Amsterdam, Holland, and was for some years head of the Buffalo Street Railways, spent the past week at San Francisco on business. He is promoting a one hundred million-dollar merger of the numerous export lumber mills of Oregon and Washington.

Thomas M. Moore, the mechanical engineer who had charge of the machinery and power divisions of the expositions at St. Louis and Buffalo, arrived at San Francisco during the past week. He has been selected by the directors of the Panama-Pacific International Exposition Company to consult with them concerning power problems in connection with the coming World's Fair.

J. D. Douglas, manager of a suburban railway line extending out of Auckland, New Zealand, recently arrived at San Francisco by steamer. He is figuring on electrizing the system and will inspect electric roads in this country. He will possibly make extensive purchases of electrical equipment. While the car bodies could be built in New Zealand, the electrical machinery would be imported.

J. G. Henninger, the illuminating engineer of the National Electric Lamp Association, will deliver a lecture before the "Electrical Vehicle Association of America" which holds its annual convention in New York City, October 10th. His paper will cover the illumination of public and private garages, and also touch on the lighting of automobile sales rooms. As there is little information on such matters, Mr. Henninger's lecture will no doubt prove of much interest and value to automobile men, who desire to secure the best illumination possible for their particular use.

ELECTRICAL CONTRACTORS' NOTES.

The McFell Electric Company have been awarded the contract for installing a lighting system at Fort Miley for the sum of $17,200. This bid is $700 above the lowest bid, but the Government engineers figure that it is the best bid, as the McFell Company agrees to install the work in 120 days, against 180 days, which the lowest bidder wanted. This company has an office in Chicago, as well as San Francisco, and have done some very large work in this city. Among their jobs are the Merchants' Exchange, Royal Insurance Building, the Y. M. C. A. Building and the Bohemian Club. The San Francisco office is in charge of Frank Watts, who is considered by the contractors as one of the leading men in the contractor's business.

The Native Sons' Hall has been let to the Standard Electric Company for the sum of $6000.

Decker Electric Company have been awarded the contract for the Terminal Hotel.

Among the jobs that are ready for figures at present are the Standard Oil Building, Regents Hotel, Downtown Realty Theater and Hotel.

PACIFIC COAST BRANCH OF IDEAL ELECTRIC AND MANUFACTURING COMPANY OF MANSFIELD, OHIO.

S. Glen Vinson, secretary and general manager of the Ideal Electric and Manufacturing Company, Mansfield, Ohio, has been in San Francisco the past week for the purpose of establishing a branch house on the Coast. R. B. Elder has been appointed sales manager.

It speaks well for the company who, in the past three years, has increased its business to that extent that they are obliged to maintain their own establishment and carry a large stock of goods on the Coast to care for their trade.

INDUSTRIAL

MAGNETIC CHUCKS.

As a labor saver there is probably no form of electrical device that will prove of greater benefit in the machine shop than the magnetic chuck. It possesses a very wide range of usefulness in holding pieces on the grinder, shaper and milling machine and where a large number of pieces are to be machined, it will frequently be found that the labor saved by the use of such a device as compared with old methods of clamping or bolting will pay the entire first cost of the chuck within the first week or ten days of service.

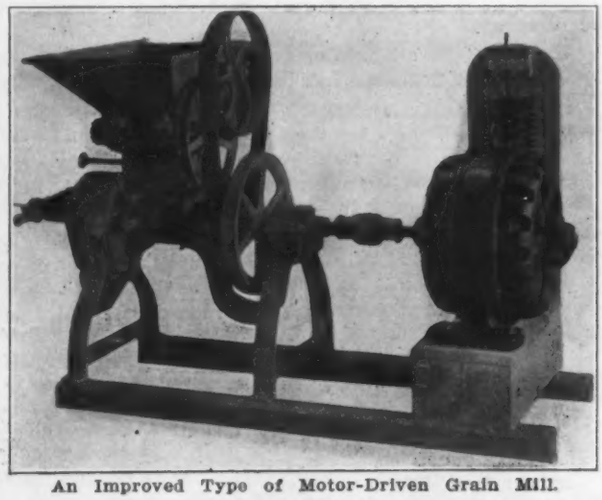
Magnetic Chuck.

In the magnetic chucks which are being placed upon the market by the D. & W. Fuse Company of Providence, R. I., the difficulties which were prevalent in the early chucks designed have been eliminated. Trouble was formerly experienced due to the burning out of the magnet coils, where the chuck was put into prolonged service. In the D & W chucks the magnet coils are practically indestructible by overheating as they are wound with Delabeston Wire, or special heat-proof insulation of pure asbestos, which we manufacture and which can safely withstand continuous temperatures as high as 400 degrees Fahr. without destruction. Furthermore, the coils are so designed that should they accidentally become injured, they can be readily removed by the workman and a new coil inserted at slight expense.

The chucks are both oil and waterproof and are equipped with a demagnetizing switch for readily releasing the work.

MOTOR DRIVEN GRAIN MILL.

Electricity is becoming more and more of a factor on the farm, and especially those farms which can easily procure central station power. The accompanying illustration of an



An Improved Type of Motor-Driven Grain Mill.

electrically driven No. 2 Kelly Duplex Mill is an excellent and popular example of the advantages of electric drive and another factor in building up the day load.

The mill is the product of the Duplex Mill and Manufacturing Company of Springfield, Ohio, and is a great favorite with feed dealers, farmers and stock feeders. It will grind any kind of grain, cotton seed, corn cobs, and shucks, and produce a grist of any desired quality, coarse, medium or fine.

The grinding surface is just double that of the ordinary mill, owing to a double set of grinders or burrs, for which reason it is called the Duplex. A device is provided to permit regulating the feeding of small grain from the base hopper into the crushers. This prevents the grain from clogging in the hopper and causes an even and ready flow. The application of electric drive insures a maximum capacity for grinding with the least operating expense and affords an efficient and reliable source of power at all times.

This mill is driven by a 7½ H. P. alternating current induction motor manufactured by the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa.

TRADE NOTES.

The Pelton Water Wheel Company has closed a contract with the Montesano Light & Water Company for a Pelton-Francis turbine, direct connected to Westinghouse generator, which will be used to increase the capacity of the system at Montesano, Wash.

The Crocker-Wheeler Company, Ampere, N. J., announces the resignation of Mr. Gano Dunn who for a great many years has filled the position of chief engineer and first vice-president in the Crocker-Wheeler Company with conspicuous ability, and he leaves with the very best wishes of the company and his many friends and associates in it, for his future success.

The General Electric Company has sold to the Siskiyou Electric Power & Light Company two 500 kw. water-cooled transformers of 34,600-v.—60,000-v Y primary, 10,000 v. secondary; three 300 kw. water-cooled and two 300 kw. oil-cooled transformers, of 34,600-v.—60,000-v Y primary, 2,300-v. secondary. Also three sets of aluminum cell lightning arresters for outdoor use and one set for indoor use.

F. C. Foster, manager of the Pittsburg office of The Buckeye Electric Company, seems ambitious to become the aviator of the electrical industry. At the convention of the Pennsylvania Section of the National Electric Association Mr. Foster made a balloon ascension at Lake Conneaut which should entitle him to recognition by the Aero Club. The balloon reached an altitude of sixty-four hundred feet and covered a distance of over thirty miles before landing near Meadville, Pennsylvania.

BOOK REVIEW.

McGraw Electric Railway Manual. Successor to American Street Railway Investments. Edition of 1911. By Frederic Nicholas. Size 9x13 inches; 430 pages. Transportation maps for all large American cities; clear type; strong paper; durable binding. Published by McGraw Publishing Co., and for sale by Technical Book Shop, 604 Mission St., San Francisco. Price $7.50.

A complete summary of this interesting and valuable book appeared in the reading columns of the Journal of September 16. The book is so full of items relative to American railway practice, it is difficult to describe it in brief. Tabulations of earnings, expenses, balance sheets, statistics of operation, track and equipment, together with the names and addresses of officers and directors of the electric railway companies of America, make the book absolutely indispensable to all those who desire quick and accurate information.

NEWS NOTES

FINANCIAL.

NOGALES, ARIZ.—The bonds for a water system and also those for a sewer system have been carried by a large majority.

ASOTIN, WASH.—The taxpayers of Asotin have voted to bond the town for $35,000, to provide funds for the installation of a modern water system.

LONG REACH, CAL.—The $850,000 bonds authorized at the recent special election to pay for the purchase of the Long Beach and Alamitos Water Companies were sold to these two companies by the council at par and accrued interest.

CALISTOGA, CAL.—A deal of considerable importance to Calistoga and the upper Napa Valley was consummated when William Spiers sold his electric light business to the Napa Valley Electric Co., whose principal place of business at present is St. Helena.

BRIGHAM CITY, UTAH.—The election held at Honeyville went in favor of bonding the municipality in the sum of $12,000 for waterworks and electric light and power purposes. It is estimated that $7000 will install the waterworks, while the balance of $5000 will install electric lights.

YREKA, CAL.—The Siskiyou Electric Power & Light Co. has purchased the electric power and light plants of the Rogue River Electric Company and of the Prospect Construction Company, including several hundred miles of high tension wire in Southern Oregon. When the construction work now in progress is completed, a total of 80,000 h.p. at low water will be developed with a reservoir storage which will contain a peak load storage capacity of 60,000 h.p.

AUBURN, CAL.—The Pacific Gas & Electric Company will expend $10,000,000 in extending its power system. The additional hydroelectric capacity of the company's system will include a tower line from a power plant on Bear River, Placer County, to the Bay centers. The power plant is to be erected on property that was formerly owned by the South Yuba Water Company's system. The system was absorbed by the Pacific Gas & Electric Company the first of the present year. The Pacific Gas & Electric Company now has a total capacity, in eleven installed plants, of over 90,000 h.p. and in steam plants of over 50,000 h.p. The plans, in the proposed extension, will give an additional 71,000 h.p. Plans in the proposed extension also include the extension of a dam in the canyon of the South Yuba River, below Lake Spaulding, which will increase the present existing power storage, which is obtained from 15 lakes in Placer and Nevada counties, by 2,500,000 cubic feet. From this storage reservoir the water will be conveyed through tunnels and ditches to Bear River. The first plant will have a head of 1647 feet, developing 50,000 h.p. and the second plant will have a fall of 750 feet, with a capacity of 21,000 h.p. Active work is now going on at the dam site below Lake Spaulding. Surveys have been commenced for all the tunnels and canals necessary. Rights of way are being obtained for a tower line to tie in with the present system of the company, which covers the entire portions of Central California and aggregates, in high tension lines alone 1100 miles.

ILLUMINATION.

ELLENSBURG, WASH.—Bonds in the sum of $110,000 have been passed at an election for improvement of the municipal lighting plant.

MORTON, WASH.—The commissioners have granted a franchise to A. W. Van Arsdale for the installation of a water and light system at this place.

TACOMA, WASH.—Petitions have been received for the installation of street lights on certain avenues.

NORTH YAKIMA, WASH.—The Pacific Power & Light Company has received a cluster lighting power contract at this place.

VICTORIA, B. C.—The special council commission has awarded the contract to Hutchinson Bros. at $5827 for the installation of cluster lights on Fort street.

SAN BERNARDINO, CAL.—The City Council has passed an ordinance granting to Fred B. Mechling a franchise for an electric system for transmitting electricity for light, heat and power.

McMINNVILLE, ORE.—This place will install a cluster lighting system on the principal streets. Ornamental poles with three lights will be placed and wires installed underground.

PASCO, WASH.—Bids will be received by L. H. Koontz, city clerk, up to September 19th, for constructing conduits preparatory to the installation of ornamental lamps for street lighting as per plans on file at office of said city clerk.

PASCO, WASH.—Bids will be received by the City Council, L. H. Koontz, city clerk, up to September 26th, for furnishing and installing a quantity of ornamental lamp posts with cluster lights, globes, and equipped with all wiring and conduits.

DORRIS, CAL.—James R. Tapscott, attorney for the Siskiyou Electric Power & Light Company of Yreka, has made application for a 50-year franchise for his company. The matter will be decided on at the meeting of the town board November 6.

PASADENA, CAL.—Residents and property owners of Kenoak Tract have taken steps toward securing a lighting system for Kenoak drive, using an underground system. A committee has been appointed to take up the proposition with city officials and the Edison Electric people.

LONG BEACH, CAL.—The Board of Directors of the Long Beach Consolidated Gas Company has authorized the expenditure of $250,000 for a gas plant to be erected in the northwest section of the city. All gas used by the city will then be piped from a 500,000 cubic foot tank in inner harbor, another tank, called the relief holder, will be erected and a short time afterward a tank with a capacity of 1,000,000 feet will be erected. This will give the entire plant when completed, a capacity of 11,800,000 cubic feet. F. A. Green is manager of the company.

PENDLETON, ORE.—Engineers representing the Pacific Power & Light Company and the Pacific Telegraph & Telephone Company, in a recent conference with the city council, submitted estimates for the installation of underground wires. According to figures compiled by the lighting company's engineers, it would cost the company approximately $20,900 for underground wires on Main and Court streets, while it would cost property owners in the same district $35,000. The company asked the municipality to employ an engineer to verify the reported figures, and which will be considered by the council. The telephone company's report was short and stated that underground wires would cost $20,000.

INCORPORATIONS.

MARTINEZ, CAL.—The Mt. Diablo Telephone Company of Martinez has been incorporated with a capital stock of $5000, by H. C. Wetmore, president; Charles Gordon, secretary; Percy Douglas, treasurer, and twelve others.

SACRAMENTO, CAL.—A $10,307.50 filing fee was paid to the State yesterday when the Pacific Electric Railway Company of Los Angeles, capitalized at $100,000,000 filed articles

of incorporation with the Secretary of State. The new company is composed of eight electric railways, radiating from Los Angeles as follows: Pacific Electric Railway Company, Los Angeles Interurban Railway Company, Los Angeles and Redondo Railway Company, the Riverside and Arlington Railway Company, the San Bernardino Valley Traction Company, the Redlands Central Railway Company, the San Bernardino Interurban Railway Company, and the Los Angeles Pacific Company. These railroads comprise those in which H. E. Huntington is interested. The new board of directors is composed of Wm. F. Herrin of San Francisco, R. C. Gillis and Paul Snoup of Los Angeles, W. C. Martin of San Francisco, and Epes Randolph of Tucson.

SAN JOSE, CAL.—A $2,500,000 company has filed its articles of incorporation with the county clerk here, under which it is planned to operate a line of steamers from Alviso to San Francisco in conjunction with an interurban electric railway from this city. The corporation is known as the San Jose Terminal Railway Company, and the principal stockholders are M. J. Gardner of Stockton, John A. Mehling of San Jose, H. H. McCloskey of San Francisco, Hugh Center of San Jose and Valentine Koch of San Jose. M. J. Gardner, the principal stockholder, is president of the Stockton Terminal Railway.

The articles of incorporation call for the operation of a line of freight steamers between San Francisco and Alviso, as well as passenger boats. The company plans to build a terminal station at Alviso, or rather at Beacon 13, in the San Francisco Bay, on land owned by the Dumbarton Land Company of which H. H. McCloskey of San Francisco is a large owner.

TRANSMISSION.

WILLOWS, CAL.—The Northern California Power Company is planning to enter Arbuckle with its lines.

FOLSOM, CAL.—The Pacific Gas & Electric Company will construct a power line from Folsom to Roseville in the near future.

WEAVERVILLE, CAL.—The bid of the Trinity Dredging Company for a franchise for an electrical transmission line over the county roads near Lewiston in the sum of $144, has been accepted.

PETALUMA, CAL.—The Pacific Gas & Electric Company has decided to extend its power lines from this city to Penngrove and from Petaluma to Mountain View avenue district, and also through the Sunny Slope district.

CHEHALIS, WASH.—Announcement has been made that the Washington-Oregon Corporation would extend its wires to Haskil for the purpose of furnishing power to the rock quarry there and also to furnish lights and power to Littell and Adna en route.

LOS ANGELES, CAL.—The Pacific Gas & Electric Company has decided to construct a large storage reservoir in the Sierra Nevada Mountains several miles above Nevada City to cost about $3,000,000. Two hydroelectric power plants will also be erected.

RIVERSIDE, CAL.—The Edison Electric Company has secured a site near Bloomington depot on which a sub-station will be erected at once. This plant will supply the community with electricity. The company will also install a number of arc lights on the streets.

VACAVILLE, CAL.—Supervisor Glendon presented an ordinance granting to the Pacific Portland Cement Company, Consolidated, a franchise to erect and maintain poles and wires over a certain described public highway in Vacaville township. The ordinance was adopted.

SALINAS, CAL.—Two bids were received for an electric power line over the county roads up the Salinas Valley. One from F. G. Baum, representing the Monterey County Gas & Electric Company for $200, the other was $106, from Frank J. Griffin. The bid of Mr. Baum was accepted.

COLTON, CAL.—The Southern California Edison Company has purchased a block on Mt. Vernon avenue, where it will run a plant in opposition to the Sierra company, which is erecting a plant at San Bernardino. Over $16,000 will be expended on the building here, which will be a two-story concrete structure. This will be the distributing plant for all of this part of the valley.

ONTARIO, ORE.—The contract for furnishing the power for the pumping plants for the Ontario-Nyssa irrigation project has been awarded to the Idaho-Oregon Light & Power Company. The contract is for 25 h.p. for the season, the current to run night and day for six months, the light company to furnish the transformer. The company also contracts to build an electric line along the ditch to accommodate owners of individual pumping plants who desire to raise water above the main ditch for irrigation purposes, and will build such a line one mile for every 10 h.p. contracted for.

TRANSPORTATION.

SEATTLE, WASH.—The Seattle, Renton & Southern Railway, Columbia station, will erect a one-story frame substation at 5033 Rainier avenue, to cost about $1000.

VALLEJO, CAL.—A contract for the grading on the Vallejo & Northern Railroad line within the city of Vallejo will be let soon, says President T. T. C. Gregory of the Vallejo & Northern.

CUCAMONGA, CAL.—Upland parties have stated that the Ontario and San Antonio Heights Electric Railroad will be extended to Cucamonga from Upland provided free right of way can be secured.

LIVINGSTON, MONT.—The Madison River Power Company will extend its line from Livingston to Lewiston, through the Shields River Valley, according to announcements made by General Manager Max Hebgen.

SAN DIEGO, CAL.—The City Council has passed an ordinance granting to the San Diego Electric Railway Company a franchise to construct, maintain and operate for a period ending September 1, 1952, a street railway on certain streets of the city.

SAN JOSE, CAL.—An ordinance granting to the Peninsular Railway Company a franchise for a single or double track standard gauge electric railroad in the county of Santa Clara, and also upon Willows street, Selmas avenue and Lincoln avenue, has been passed by the Board of Supervisors.

CHEHALIS, WASH.—The Washington-Oregon Corporation has closed contracts with the State of Washington to supply all electric power for the operation of the convict rock-crushing plant, at Meskill, 12 miles west of this place. Construction of the pole line and installation will start at once.

LOGAN, UTAH.—The Cache County Commissioners have granted a franchise to the Ogden, Logan & Preston Railway Company, to operate within the county an electric or gasoline railway. It is the intention of the company to construct an electric road from Ogden, through the Cache Valley to Preston.

SAN FRANCISCO, CAL.—Announcement is made by General Manager Furlong of the West Side Railway Company that a new electric railway from Sacramento down the river to Rio Vista, tapping some of the rich lands in California, will be in operation within a few months. Actual construction is about to be begun by the company, which is backed by E. R. Lilienthal and associates, who will invest nearly a million dollars in the project.

VALLEJO, CAL.—Extensive plans for the improvement of Vallejo's water front are contemplated by the officials of the Vallejo & Northern Railroad Company as an adjunct of their terminal and grading work in this city. The company owns about 25 acres of tide lands in the vicinity of the foot of Alabama street, where the railroad's terminal will be constructed and it is planned to fill in the tide lands with dirt and rock excavated at other points along the route.

SEATTLE, WASH.—B. H. Graff, contractor, American

Bank building, has received the contract for the construction of a one-story power substation at the foot of Nelson place, for the city of Seattle, at a bid of $8631. The remaining bidders were: S. &C. Carkeek, at $8685; Bartz & Grant, $9556; G. F. Mowat, $10,535; Rounds & Hurson Co., $11,750; A. W. Quist & Co., $12,309; W. G. Clark, $12,500; John Galber, $12,987, and the Butler Construction Company at $14,000.

KOOTENAI FALLS, MONT.—It is reported that a Massachusetts syndicate will shortly undertake the development of 80,000 h.p. electrical energy at this point, for distribution in Western Montana, Northern Idaho and Northeast Washington. J. A. Coram, of Boston, counsel for the corporation, is responsible for the announcement. The plant is proposed to be located seven miles east of Troy, Mont., and at a total cost of $6,000,000 will require two years for completion. The main power transmission lines will be as follows: Kalispell, Mont., 100 miles; Spokane, 90 miles; Wallace, Idaho, 60 miles; Sandpoint, Idaho, 38 miles, and Republic a distance of 140 miles.

FRESNO, CAL.—Promoter F. S. Granger states that he had received $10,000 from the Guaranty Trust Company of New York and the Underwriters Company of Philadelphia. Granger announced that the laying of rails would begin October 15. The material such as ties and rails, will begin to arrive about October 5. Grading work on the interurban line is about completed. To date, 35½ miles have been graded, leaving but a half mile to be prepared. When the ties and rails arrive the laying of track will commence just outside the city and the line will be extended in the direction of Selma as quickly as the work can be done. According to Granger, the grading crew has been doing rapid work and the entire route will be ready for ties and rails by the middle of next week. Granger plans to have the first cars in operation on or about February 1, 1912.

LOS ANGELES, CAL.—With the filing of the incorporation papers of the new Pacific Electric Railroad at Sacramento last week, official announcement was made that its present trackage of 875 miles would be increased to 1875 miles, while the scope of territory made tributary by these extensions would be more than quadrupled. Work on a portion of the new lines is already under way and it is officially stated that construction of the entire system will be carried forward as fast as material can be secured and rights of way and terminal facilities obtained. Here are the extensions which are made a matter of record in the articles of incorporation of the new concern.

The Glendora line will be extended to San Bernardino. The Covina line will be built through Pomona to Riverside. A city trolley service is being installed in Riverside. From the La Habia line a line will be run to Riverside with a branch to Santa Ana. From a point on the Covina line to Long Beach a new cutoff will be run. A line will be built through the San Fernando Valley and to Santa Barbara, with a branch to the town of San Fernando. From Santa Monica a line will be run northeast to San Buenaventura. San Pedro will be connected with Redondo by a new line across the peninsula back of the range of hills. From Santa Ana a trunk line to San Diego will be built. A short line cutoff from the present four tracks will greatly reduce the distance and running time to South Pasadena. Much additional trackage will be installed at many times along the shores of Los Angeles Harbor.

Power for the system, which will be more than doubled when the announced plans are carried into effect, will be supplied by the Pacific Light & Power Company, which already has under construction in the San Joaquin Valley, a plant which is intended to generate greater voltage than now comes from the harnessing of the Niagara.

TELEPHONE AND TELEGRAPH.

PETALUMA, CAL.—The Guglielmetti Rural Telephone Company will extend its telephone line to Cotati.

TERRA BELLA, CAL.—The organization of the Ducor-California Hot Springs Telephone Company, a co-partnership company, has been perfected and L. S. Wingrove elected president.

DAYTON, WASH.—An ordinance has been passed by the City Council granting a franchise to the Mount Vernon Telephone Company to build a telephone line along certain streets of the city.

LA PORTE, CAL.—The construction of a new telephone line to the Bellevue mine near Gibsonville and to the Tamarac Flat station near Franklyn Himm on Lunipkin River has been started by the forest service.

ABERDEEN, WASH.—Chesterfield & Van Buskirk, contractors of Tacoma, have been awarded the contract for the construction of the new building to be erected on Market street, opposite the city hall, by the Pacific States Telephone and Telegraph Company, at a cost of $35,000.

NEVADA CITY, CAL.—James Dolan, superintendent of construction in Nevada and Sierra Counties for the Pacific Telephone & Telegraph Company, is awaiting orders from the head office to start the construction of a new telephone line from Camptonville, Yuba County, to Loyalton, Sierra County, a distance of over 80 miles.

WATERWORKS.

WAPATO, WASH.—Wapato residents have decided to adopt the municipal waterworks system as prepared by Engineer Redman.

SISSON, CAL.—This town has voted in favor of a bond issue of $40,000 for the construction of a water plant and the building of a city hall.

OXNARD, CAL.—Engineers are preparing plans for a municipal water system to cost about $100,000. A bond election for improvements will be held soon.

REDLANDS, CAL.—Engineer Hinckley has completed plans for the construction of an independent system of water mains for the business section of this city for fire protection use.

RENO, NEV.—Bids were received by the Board of Trustees of the town of Alturas, Modoc County, Cal., up to Sept. 13, 1911, for the construction of the waterworks of the town of Alturas.

SAN DIEGO, CAL.—The Hazard Gould Company has been awarded the contract for extending the Sweetwater water system to the Fairfield tract on the bay side of Chula Vista. This will cost about $4000.

CENTRALIA, WASH.—The construction of a joint water system for the city of Centralia and Chehalis to be owned and operated by the cities, is a feasible proposition. The approximate cost is estimated at $115,000.

ORANGE, CAL.—The City Council has passed a resolution determining that public interests and necessity demands the construction of a water system, also the construction of a waterworks building at a cost of about $50,000.

SPRAY, ORE.—S. L. Cross and S. C. Johnson are to put in a water system for the town. A well ten feet in diameter is being dug in Spray. Additional water will be pumped through two-inch mains to a concrete tank 20x30.

OGDEN, UTAH.—The David & Weber Counties Canal Company has awarded a contract to the Lynch-Cannon Company for the erection of its waterworks plant near Riverdale. This improvement when completed will represent an investment of $250,000.

LYLE, WASH.—The Puget Sound Bridge & Dredging Company, Central building, Seattle, is assembling materials and equipment for the construction of the Northwestern Electric Company's dam on the Klickitat River, near this city. The dam will be utilized to irrigate 6500 acres by ditch and will cost $100,000. The completed survey demonstrates, it is stated, the practicability of a project to cost $500,000.